THE

# ELECTRICAL REVIEW.

VOL. LIV. MAY 13, 1904. No. 1,381.

## ELECTRICAL REVIEW.

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THE

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## THE ELECTRIC LIGHTING BILL, 1904.

THE Government Bill which was introduced into the House of Lords by Lord Wolverton, on May 2nd, to amend the Acts relating to electric lighting, should receive the careful attention of local authorities and companies who are interested in the supply of electricity. We have often urged the need for reform; we have often expressed surprise that the recommendations of the Joint Committee in 1898 have not been acted upon before this; it is pleasing to see that the Legislature has at length turned its attention to the matter.

The chief reforms suggested are (1) the grant of power to the Board of Trade to allow undertakers to acquire land compulsorily; (2) an alteration of the existing law as to compulsory purchase by the local authority of an undertaking belonging to a company; (3) a proposal to deprive local authorities of the power which they now possess to *veto* the grant of a provisional order to private companies within their area.

As to the first of these, the Bill empowers the Board of Trade to make provisional orders to authorise any local authority, company, or person already authorised to supply electricity in any area "to acquire compulsorily for the purpose of a generating station any land specified in the order, whether situated within or without the area of supply, and in the case of a local authority, whether situated within or without their district," proper notice having been given to owners, lessees, and occupiers of land and to the public, of their intention to apply for such an order. This is a great advance upon existing legislation. Under the Electric Lighting Act of 1882, those who supply electricity under an ordinary provisional order, merely have power to enter into agreements for the purchase of land for generating stations. If compulsory purchase is required, the matter has to be specially provided for in an Act of Parliament. Of course the matter has often been well settled by agreement, but the Bill under discussion gives power to acquire land not only within the area of supply, but outside that area. Hence, if promoters think that a generating station can be built at less cost at a particular place, they can obtain the necessary power to do so, without the expense of promoting a special Act of Parliament. It may be thought a strong measure to give the Board of Trade power to allow land to be acquired by compulsory purchase; but a power to do this has already been vested in, and has been exercised by, the Light Railway Commissioners. The Bill further provides that the Board of Trade may allow promoters to break up any road, railway, or tramway, of course, upon the usual terms as to making good any damage which may be so occasioned.

We have only to refer to Sec. 11 of the Electric Lighting Act, 1882, to understand how great an advance is made by the new Bill. That section provides that:—

**Any local authority who have obtained a license, order, or special Act for the supply of electricity, may contract with any company or person for the execution and maintenance of any works needed for the purposes of such supply, or for the supply of electricity *within* any area mentioned in such license, order, or special Act, or in any part of such area; but no local authority, company, or person shall by any contract or assignment transfer to any other company or person, or divest themselves of any legal powers given to them, or any legal liabilities imposed on them by this Act, or by any license, order, or special Act, without the consent of the Board of Trade.**

With regard to the compulsory purchase of undertakings by local authorities, the Bill makes a very important alteration in the law. As our readers are probably aware, it is provided by Sec. 2 of the Electric Lighting Act, 1882, that within certain periods after a provisional order comes into force, local authorities now have power to purchase the undertaking of a company on the terms of paying:—"The then value of all lands and buildings, works, materials, and plant of such undertakers suitable to, and used by, them for the purposes of their undertaking within their jurisdiction, such value to be in the case of difference determined by arbitration, provided that the value of such land, buildings, &c., shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, &c., and to the state of repair thereof, and to the circumstance that they are in such a position as to be ready for immediate working, &c., but without any addition in respect of compulsory purchase or of goodwill, or of any profits which may or might have been or be made from the undertaking, or of any similar considerations." Realising the damping effect which this clause was having upon electrical enterprise, the Joint Committee in 1898 recommended that "the Board of Trade should have power to insert the purchase clause in the provisional order, if the local authorities concerned can . . . . show good cause." Unfortunately, the Bill under discussion does not go quite so far as this, but it provides that the Board of Trade may, by provisional order, exclude the power of compulsory purchase given by Sec. 2 of the Act of 1888. If this power is exercised, the local authorities interested must first be notified, and their objections, if any, must receive consideration. It is presumed that in deciding such a point the Board would consider the likelihood of the local authority ever exercising the option sought for.

We now come to consider the section which alters the existing law as to veto by the local authority. Hitherto the local authority has had power to refuse consent, and the consent must not be dispensed with except in cases where the Board of Trade thinks proper to make an order to that effect. In future, if the Bill under notice becomes law, the consent of the local authority is dispensed with, but, of course, the Board of Trade must hear any objections to a provisional order in favour of a company which may be put forward by the local authority. This amendment of the law would have the desirable effect of enabling a private company to obtain an order to supply electricity for the benefit of the inhabitants of a district whose local authority desired to reserve the right to supply for the ostensible benefit of ratepayers. It is a recognition by Parliament that the system of surrendering the entire right to supply electricity to municipal bodies has been examined and found wanting.

The Bill makes another change which is worthy of passing notice.

It is provided by Sec. 32 (1) of the Electric Lighting (Clauses) Act, 1899, that the prices to be charged by the undertakers for energy supplied by them shall not exceed those stated in that behalf in the special order, or in the case of a method of charge approved by the Board of Trade, such price as the Board of Trade determine on approving the method.

Provided that if in a case where the local authority are not themselves the undertakers, either the local authority or the undertakers at any time after the expiration of seven years, after the commencement of the special order, make a representation to the Board of Trade that the prices or methods of charge stated in the special order or so approved as aforesaid, or substituting other prices or methods in lieu thereof, and the prices or methods of charge so varied or substituted shall have effect on and after such day as may be mentioned in the order as if they had been stated in the special order. Provided also that the prices and methods of charge for the time being in force may be altered in like manner at any time after the expiration of any or every period of seven years after they were last altered.

The new Act provides for a quinquennial instead of a seven-yearly revision of the maximum price. It also amplifies and amends the provisions of the Electric Lighting (Clauses Act), 1899, as to the certification of meters.

There are certain other reforms which we would be glad to have seen provided for; but a little reform is better than nothing. We trust that the exigencies of public business may permit this measure to become law in the present session.

---

What is a Reserve Fund?

As a result of the difficulty which has been experienced of late in raising money for industrial and other purposes, there is a tendency on the part of some companies which have been so fortunate as to accumulate reserve funds, to invest such funds in their own businesses. We must confess that while we fully appreciate the significance of the arguments which are used in justification of this procedure, and though it may be intended merely as a temporary expedient, we cannot view the practice with feelings of satisfaction. The great value of a reserve fund to any company lies in its existence in liquid form, so that it is easily realizable; therefore, however low the rate of interest may be, compared with the possible profit that might be earned on the money if employed in actual manufacturing operations, the investment of such a fund in sound marketable everyday securities which show a minimum of fluctuation, is the only really safe course to be adopted. We, of course, particularly apply these remarks to electrical manufacturing companies, because during recent years some undertakings of this kind have by the vicissitudes of fortune been made to show a very variable business curve with some ugly drops, and it is conceivable that the existence of a substantial reserve might tide such companies over an awkward year, when without it they might find themselves in trouble.

We do not doubt that in isolated instances there may be condoning circumstances, but we have no wish to speak exclusively of the several recent instances which have occurred in connection with this industry; rather do we wish to urge upon electrical companies *en bloc*, the undesirability of carrying this sort of thing too far. It is, no doubt, an elementary piece of advice to give, but some everyday truths are often the least recognised, and we think it will be timely if, in simple terms, we offer the reminder that it is better to invest a reserve bearing a low rate of return and have safety,

than to convert your reserve into an increase of capital, and weaken a concern which may chance to fall upon bad days.

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Power Station Design.

THE paper on this subject contributed by Messrs. Merz and McLellan to the proceedings of the I.E.E. will certainly rank amongst the best and most useful of the session now drawing to a close; and, fortunately, sufficient time has been allowed for a fairly adequate discussion. In passing, we may once more point out that too much time is wasted in reading, or whispering, papers before the members, and too little is often allotted to the discussion. If fewer papers were accepted, and those more fully discussed, while other papers of merit were published as original communications, we think that greater profit would result.

Returning to the paper above-mentioned, although some speakers suggested that everybody knew it all long ago, we take leave to say that in many cases this fore-knowledge has been admirably concealed. The ring main, of which we have so often pointed out the disadvantages; the unjustifiable expenditure on buildings of ornate design; the lavish provision of auxiliary appliances, which cost more than they save; and the excessive complication of switchboards, providing for all sorts of alternatives, instead of rendering them superfluous by simple and sound design—all these are faults which are being repeated even to-day, and the authors are to be congratulated upon their vigorous denunciation of such practice.

Their frank advocacy of the Parsons turbo-generator is all the more weighty, seeing that it is based upon practical experience with this type of plant, and that their Carville station is being wholly equipped therewith; but it was unfortunate that gas engines were passed over so lightly, as the gas engine is a factor in future power-station design which cannot be ignored.

Turning to the discussion, which was of more than ordinary interest, the remarks of Colonel Crompton were amongst the most striking. He stated, from his own experience, that gas-driven plant was a practical success, at any rate up to 1,000 KW.; that by an improved boiler-setting he could evaporate 9 lb. of water per lb. of coal containing no less than 30 per cent. of ash; and that renewed trials of the Druitt-Halpin thermal storage system had revealed the remarkable fact that the evaporative capacity of a boiler could be trebled thereby, thus greatly reducing the capital outlay, and improving the load factor of the steam-raising plant. The first and second of these statements are the most important, and are in harmony with the views which we have consistently put forward for years past. As to the future supremacy of internal combustion engines we entertain no doubts. As for the question of bad boiler setting, we have pointed out *ad nauseam* that the present setting of boilers, especially water-tube boilers, is wholly wrong; neither efficiency nor smokelessness can possibly be attained unless ample space is allowed over the grate for perfect combustion to take place. In this connection, we have pleasure in acknowledging the valuable work done by our esteemed contributor, Mr. W. H. Booth, who long ago realised the futility of the present methods, and has persistently advocated in our columns the scientific treatment of fuel combustion. We regret that Col. Crompton did not see fit to refer to Mr. Booth's prior work in this direction.

As for the thermal storage system, we must confess that we have no faith in it. Storage ought to be carried out at the electrical end of the installation—preferably at the end of the feeders—not at the beginning! When one considers that not more than 10 per cent. of the energy thermally stored is eventually supplied to the mains, and that it in no way diminishes the capacity of the engines, dynamos, switchgear, or feeders, improves their load factor, or adds to the reliability of supply, one cannot help clearly seeing the fallacy of the system.

## THE THERMAL EFFECT AND THE PRACTICAL UTILITY OF SUPERHEATED STEAM.

By ROBERT H. SMITH.

THE interesting article that appeared in the ELECTRICAL REVIEW of April 15th upon "Superheated Steam" suggests that the reason for the utility of superheating in steam-power production is obscure, and that further investigation of the specific heat of superheated steam may throw light upon the problem.

The following calculations seem to make it clear that this utility of superheating has no reason beyond that of keeping the engine cylinder walls, piston surface and valve seats and faces dry. This dryness is of immense utility. Steam of any quality parts with its heat to a wet iron wall very readily and quickly, but only slowly to a dry wall. The difference is still more marked when it is superimposed upon the difference between dry superheated steam and wet steam or just dry saturated steam. Any incipient wetness either in the steam or on the wall leads to rapid loss of heat and to consequent condensation, which increases the evil cumulatively. Dryness also appears to diminish steam leakage past valve seats.

It is true that superheating gives a thermodynamic advantage beyond the maintenance of dryness, but it is so very slight as not at all to compensate the expense of the process. The practical conclusion is that superheating should be carried only to that degree sufficient to ensure dryness in steam-pipes, valve-chests, ports, and cylinder throughout both admission, expansion, and exhaust.

Occasionally there seems to be a vague idea that the superheating takes place otherwise than at constant pressure. Superheating otherwise than in this manner is, of course, a mechanical possibility, either by mechanical compression or by reduction of pressure by passage through a reducing valve accompanied by conductive heating. But no such means are employed, and elementary common sense will prevent their employment. The pressure is the same throughout the boiler steam-space and the superheater, except when there is a great rush of steam through a superheater whose tubes have been made too small, when there will be a small unintended drop of pressure through the superheater tubes.

Again there is sometimes a vague notion that superheating at constant pressure does not increase the mechanical work done. Of course, it does do so by expansion of the steam volume and by consequent enlargement of the $pv$ product entering the cylinder per lb. of steam used. In the superheater itself extra mechanical work is done equal to the product of the pressure $p$ and the increase of volume; and this work is transmitted forwards and delivered to the cylinder-piston.

If $t_s$ be the saturation temperature at the given pressure, and if $t_s$ be measured from absolute zero, and $t$ be the extra superheat imparted, then an approximation to the ratio of expansion at constant pressure effected by the superheating is $\frac{t_s + t}{t_s} = 1 + \frac{t}{t_s}$. This would be accurate if the steam expanded as a "perfect" dry gas. Its deviation from accuracy is found to be of little or no importance so far as regards the present problem. This, then, is nearly the ratio in which the $pv$ per lb. of steam is increased by the superheating.

Whatever be the index of the expansion curve after cut-off in the cylinder, so long as this index remains unchanged, the work done, irrespective of back-pressure, during admission and expansion is proportional to this $pv$. The work $pv$ itself is originally done in the boiler and superheater, and taken in ft.-lbs. per hour, and divided by $1{\cdot}98 \times 10^6$ (*i.e.*, multiplied by $\frac{1}{2} \times 1{\cdot}01 \times 10^{-6}$) is the mechanical horse-power at which the boiler does mechanical work. This boiler mechanical horse-power is increased by superheating in the ratio $1 + \frac{t}{t_s}$ nearly.

Taking ·48 as the specific heat of steam per lb. and per 1° rise of temperature beyond saturation temperature, the amount of heat conducted to the steam per lb. to effect the superheating is ·48 $t$. If H be the total heat of 1 lb. of

saturated steam from average feed temperature, say, 60° F., the total heat for water heating, evaporation, and superheating, is $H + \cdot48\ t$, and the superheating has increased this in the ratio $1 + \frac{\cdot48\ t}{H}$.

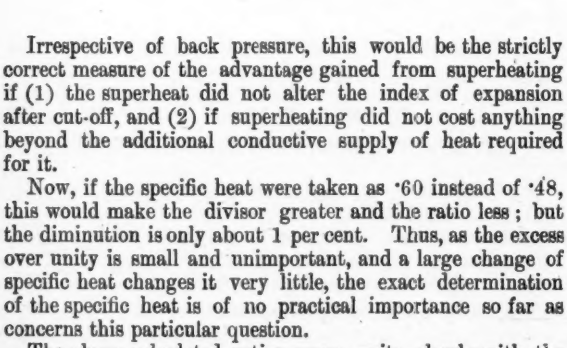
Comparing now the ratio of increase of useful product in mechanical power with that of the cost in heat conducted, the comparison is—

$$\frac{1 + \frac{t}{t_s}}{1 + \cdot48\ \frac{t}{H}}.$$

In the following table of values of this ratio the superheat is taken as 100°.

| | | | | |
|---|---|---|---|---|
| $t_s =$ | 700 | 800 | 850 | F.° absol. |
| $p =$ | 24½ | 117 | 218 | lbs./in² absol. |
| $H =$ | 1,127 | 1,157 | 1,174 | B.Th.U. from 60°. |
| $\frac{1 + \frac{t}{t_s}}{1 + \cdot48\ \frac{t}{H}} =$ | 1·097 | 1·088 | 1·074 | for $t = 100°$ of superheat. |

The table covers an extreme range of pressure, and the variation of the ratio is very slow. Per 10° F. superheat, it is about 1 per cent increase for very low, and ¾ per cent. increase for very high pressures. The annexed diagram shows the variation of the ratio with pressure, as also the total heats of saturated steam. This latter curve will also represent the total, including superheat, if the right-hand scale be marked 48 B.Th.U. higher.




Irrespective of back pressure, this would be the strictly correct measure of the advantage gained from superheating if (1) the superheat did not alter the index of expansion after cut-off, and (2) if superheating did not cost anything beyond the additional conductive supply of heat required for it.

Now, if the specific heat were taken as ·60 instead of ·48, this would make the divisor greater and the ratio less; but the diminution is only about 1 per cent. Thus, as the excess over unity is small and unimportant, and a large change of specific heat changes it very little, the exact determination of the specific heat is of no practical importance so far as concerns this particular question.

The above calculated ratios agree quite closely with the formula $(1\cdot1 - \cdot0001\ p)$. This gives the following table:—

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $p =$ | 25 | 50 | 100 | 150 | 200 | 250 | lbs./in² absolute. |
| Ratio of $\frac{\text{Increased boiler mechanical H.P.}}{\text{Increased boiler heat H.P.}} =$ | 1·0975 | 1·095 | 1·09 | 1·085 | 1·08 | 1·075 | per 100° superheat. |

For any other degree of superheat than 100°, the excess over unity is closely proportionate to the superheat.

It is very apparent that these small percentages of advantage would not in themselves justify the somewhat serious cost of superheating.

But Rankine's approximation to the index of the adiabatic expansion curve of dry saturated steam is 1·13, while that of superheated steam is taken as about 1·3. The latter falls very much more rapidly, and thus gives much less work after cut-off. If all the resilience under the two curves were developed and utilised as work done on the piston, then, inclusive of the initial $pv$ work done during admission (and irrespective of back pressure), the work obtainable by saturated steam would bear to that obtainable by superheated steam the ratio $\frac{1\cdot13}{\cdot13} \times \frac{\cdot3}{1\cdot3} = \frac{8\cdot5}{4\cdot3} = 2$ nearly, or twice as much. The effective powers developed do not bear so great a ratio for various reasons, the two main ones being incomplete expansion and back-pressure. But the ratio 2 gives a large margin for such losses, and after making deduction for these, it reduces to complete insignificance the small 1 to ¾ per cent. advantage shown in the above table. The ratio in the table is to the advantage of superheated steam, while this enormous ratio 2 is to its disadvantage.

Of course, the index 1·13 for saturated steam is a somewhat rough approximation, the actual index varying all along the curve; but the differences here considered are so large as to make it certain that the approximation is amply sufficient for the matter in hand.

Why does the saturated steam expansion curve "hold up" so much better than the superheated curve, and so give so much more indicator card area underneath it? The question and answer to it are important, because they go to the root of the whole matter. It "holds up" to an index very little over 1⅛ instead of nearly 1⅓, simply because during the expansion condensation goes on and the condensing steam "gives up" latent heat in the process. The common phrase of the physics-books "gives up" is apt to be misleading. Of course the heat is not "given up," but is retained by the water-steam. It is only converted from "latent" into "sensible" or resilient heat—heat that produces expansion, or rise of pressure or rise of temperature. This conversion into sensible heat prevents, for each degree of expansion, the fall of pressure and temperature being so great as it would be if there were no condensation; or, stated in other terms, for each degree of fall of pressure and temperature, it produces more expansion than there would be if there were no condensation. That is to say, in spite of some of the steam being converted into dense water, the heat so liberated, so expands the remaining steam that this expansion more than compensates the loss of volume by condensation.

Thus the merit of the 1⅛ index over the 1⅓ index in respect of superior resilience, developing more useful mechanical horse-power, is wholly and essentially due to its being accompanied by condensation of steam into water. But the whole merit and utility of using superheated steam in engines lies in that it prevents condensation, and keeps the cylinder and ports dry.

This sounds paradoxical, but it is true. It is so because, once any condensation is started, it is difficult or impossible to prevent excessive condensation far beyond what corresponds to adiabatic expansion. The excess beyond the adiabatic expansion drags the curve down without compensating advantages, and so as to destroy thermo-dynamic efficiency altogether. In the cylinder this excess of condensation occurs chiefly before cut-off. It is well to remember that calling the period after cut-off the "period of expansion," is a purely conventional usage of language. The admission from boiler to cylinder is also expansion, and, if it could be made adiabatic, most of the evil of the use of saturated steam would be obviated. But the fact is that, because of the physical character of the materials that must be used, adiabatic expansion of steam in steam engines is an impossibility except with superheated steam. The index 1·13 is actually a myth, so far as steam engine action is concerned. With steam not dried by superheating, the index 1·4, or even 1·5, is more likely to be common; and, in fact, on expansion into a cold cylinder during the first instants, and until it gets somewhat warmed, the drop of pressure on the $pv$ diagram must be nearly down a vertical line.

Several recent sets of experiments seem to indicate much greater leakage past valve seats with wet than with dry steam. This result, if true, does not appear to be so mysterious as it has often been considered. Leakage is a volumetric phenomenon. If the fluid-solid frictional coefficients which hinder it were the same for dry steam as for hot water, then the same volume of dry steam would leak past per second as of hot water. For equal volumes the immensely greater weight of water than of steam is ample

explanation of the measured results of the experiments referred to above. This question of leakage past valves furnishes strong argument in favour of dry slightly superheated steam in all the valve chests.

## CORRESPONDENCE.

*Letters received after first post on Wednesday morning cannot appear until the following week.*

### Some Recent Improvements in Steel Conduits for Electric Wiring.

The letter on this subject in your issue of April 29th certainly calls for attention to the two classes of tubing for installations. I have had to do with both systems from the time steel conduit was first introduced, and find that the Simplex conduit is suitable for running the circuit through at the same time as one fixes the tubing, or by drawing through afterwards by draw wires as some contracts specify; whereas if insulated tubing is used, the wires naturally twist up if put in as the tubing is fixed, or if draw wires are used, the interior insulation of piping has a nasty habit of rucking up and choking the passage, often necessitating taking the tubing out or down again to clear it, which leaves it as common screwed barrel.

As regards earthing, although a socketed tube cannot make as good a contact as a screwed one, still I have always been able to pass all earthing requirements when using Simplex, by rubbing the ends, before sealing, with a rough file.

**H. W. Rawley.**

London, S.W.

[We regret that we are compelled to hold over until next week several interesting letters on this subject.—EDS. E.R.]

### Disputed Results from a Refuse Destructor.

On page 309 of the ELECTRICAL REVIEW, dated February 19th, 1904, some astounding figures appeared relating to the refuse destructor at Burnley. Two or three deputations from other Corporations have visited this remarkable steam raising plant, but returned wiser for the visit after having had a whiff of the real article; also many letters relating to the same have reached me asking for further information.

It appears that some unauthorised person or persons have been giving misleading figures, in fact, very misleading, as will be seen when carefully perused.

Some people, no doubt, cannot refrain from sounding the big drum, but can this one be considered a Mel(odious) drum?

**R. Birkett.**

Burnley Electricity Works,
*May 3rd*, 1904.

[We are making inquires into this matter.—EDS. E.R.]

### High Temperature Feed Heating.

At the adjourned discussion on 5th inst. upon the power station paper of Messrs. Merz and McLellan, Col. Crompton stated that certain boilers, water-tubes, I believe, which were rated to give, under ordinary conditions, a maximum evaporative duty of 12,000 lbs. per hour, from and at 212° F., had been enabled, by feeding them with water at the full temperature of the boiler pressure, *i.e.*, at the temperature of evaporation, to reach an evaporative duty of 36,000 lbs. per hour.

I regret Col. Crompton did not offer an explanation of this effect. I think M. Normand, of French torpedo boat fame, was the first to publicly insist upon its feasibility, while Mr. Druitt Halpin has for some years given practical form to it in his "thermal storage" system.

I cannot find any one of the many explanations hitherto advanced of the phenomenon thus produced to be convincing and tenable, nor can I supply any better. Nevertheless, in devising my controllable system of superheating, I utilised my knowledge of the demonstrated fact, and so arranged my system of superheat control by water that, whether in the flue-fired type or in the separately fired type of my superheater, the control water, both feed and circulating, shall ultimately enter the water space of the boiler, at least, at full boiler temperature, and, in the flue-fired type, at times even in a partially evaporated condition, as "foam."

Our consulting engineer in London, Mr. W. H. Booth, has for some time ably supported me in my endeavours to interest engineers in the economical possibilities of my combined system, and, while neither he nor I would venture to predicate the regular economical performance of treble or even double duty by the boilers, we do most emphatically state that my system, by giving, simultaneously, fully heated feed water, ready for transformation and controlled superheat, very materially increases the duty and efficiency of the steam-generating plant, and permits of a sensible reduction in the number of boiler units.

In our opinion, the boiler plant in the majority of electricity generating stations is excessive. Engineers are desirous, when designing a station, to provide an ample margin of boilers beyond those necessary, working at low rates of evaporation, to supply the engines with "wet" steam. Superheaters occur as an afterthought, and a small tube superheater, giving variable superheat and loss in pressure from throttling, and subject to overheat, is added to each boiler without any attempt being made to reduce the number of boilers to counter-balance the additional cost of the superheaters; and thus the cost of the already over-capitalised boiler plant is considerably increased.

We ask engineers to consider design on a wider basis, and we suggest that, by means of my system, they could safely calculate to reduce the standard provision of boiler plant, especially of the water-tube type, on three lines, allowing always the full complement of "economisers" proportionate to the boilers:—

1. By about one-fifth, due to the lower steam consumption in the engines from superheating.

2. By that proportion of grate area utilised in the separately-fired superheater for the feed-heating work which is usually done in the boilers.

3. By the ratio of increased boiler capacity due to the phenomenon so ably indicated by Col. Crompton.

Thus, in a proposed standard installation of 20 boilers at work, plus $x$ spare boilers, the first factor would allow of a reduction of the number of boilers to $20 \times 80$ per cent. $= 16 + x$. The second would reduce the number to $16 \times 85$ per cent. = say $14 + x$; and, could Col. Crompton's optimistic estimate be realised, which we much doubt, the third factor would cause a reduction to $14 \div 3 = 4\frac{2}{3}$, or, say, $5 + x$ spare boilers.

For this third factor, our more moderate estimate of the increase in duty obtainable would be about 20 per cent., so that the final number would read—$14 \times 80$ per cent. $=$ 11·2, or, say, 11 boilers, which, with three spare boilers and four separately-fired superheater feed reheaters and one spare, would compare very favourably with the standard plant of 20 boilers and four spares, plus 24 uncontrollable small tube flue-fired superheaters.

Confronted with such an economy in plant, which is certainly obtainable with my system of separately fired water controlled superheater and feed reheater, the first cost of the superheating apparatus, which seems to deter some engineers, sinks into insignificance. Indeed, careful consideration will show that it means a saving in first or capital cost of the entire plant, with subsequent economy and increased efficiency in working.

Operating with water-tube boilers, it offers the further important advantage of carrying in the feed-heating drums a store of hot water equal, generally, to an hour's feed supply for the boilers to which it is attached.

**H. Cruse.**
*(The Cruse Controllable Superheater Co.)*

Manchester, *May 9th*, 1904.

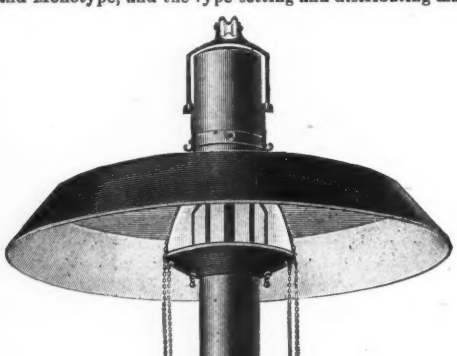
NAME WANTED.—A correspondent asks: Can you tell me who are the makers of the "Hurricane" desk type fan motors?

**Electricity for Textile Machinery.**—Last Saturday week the members of the British Association of Managers of Textile Works visited the works of the British Westinghouse Co. at Trafford Park. Mr. Halby Craig afterwards read a short paper on "The Application of Electrical Power in Textile Works."

## THE INTERNATIONAL PRINTING EXHIBITION.

The International Printing and Allied Trades Exhibition, which was opened on April 30th at the Agricultural Hall, Islington, by Sir James Henderson, President of the Master Printers' Federation, contains material of more than ordinary interest to the printing fraternity. It is claimed that the exhibition, with its 300 exhibitors, is the most representative one since the great Caxton Centenary of 1877, held at South Kensington. Since that time the photo-engraved half-tone block, and the three-colour print have caused a revolution in the printer's art; and visitors to the exhibition cannot fail to be interested in the many processes, intricate machinery and excellent productions which are on view for their edification.

Special features of the exhibition are the type-casting machines, Lino and Monotype, and the type-setting and distributing machines

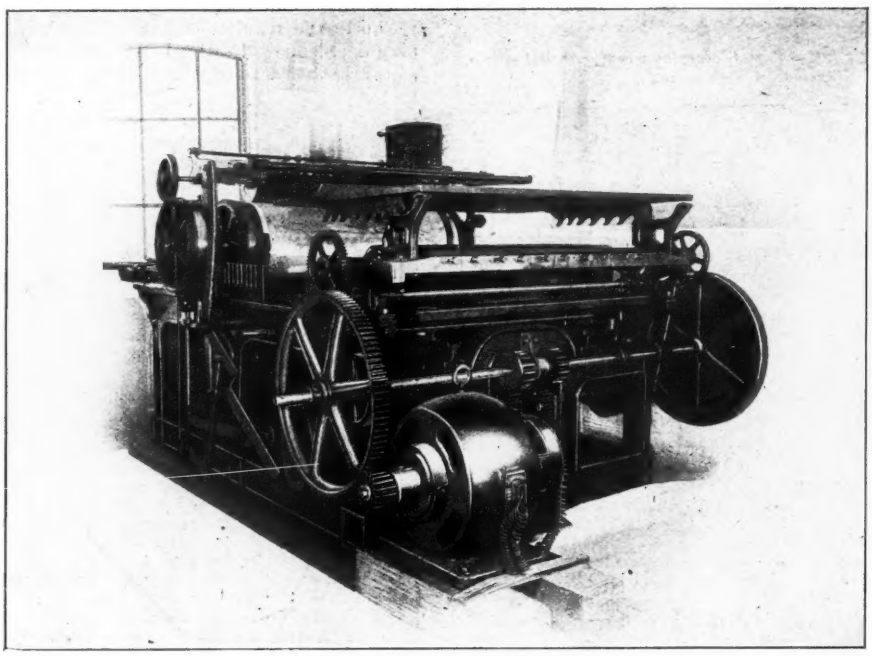


Union Partially Enclosed Inverted Arc Lamp with Special Reflector.

of the Pulsometer Engineering Co.; the exhibits of colour-printing from aluminium plates on fast rotary machines, shown on four different stands; the complete model printing plant at work on a daily paper, and to those who are artistically inclined, the excellent display of art posters, colour prints, and last, but certainly not least, if one may judge by the magnitude of the display, the ever-present picture postcard.

Turning to matters of more immediate interest, it was noticeable that a goodly proportion of the machinery in motion was operated by means of the electric motor—principally direct driving, and several well-known electrical firms were represented. One of the first to catch our eye was the stand of Electromotors, Ltd., of 35, Queen Victoria Street, E.C., and Openshaw, whose exhibit comprises a motor-generator; 5, 2½, and 1-h.p. standard motors, 2½-h.p. spur, and 2½-h.p. worm reduction gears, Sturtevant starters, reversing controllers, &c., a motor-driven fan of the Sirocco type. Six Sax 2-ampere Dot arcs, rated at 200 c.p., serve for the purpose of illumination.

The model printing works shown in operation at Messrs. John Haddon & Co.'s stand, comprises examples of modern printing machines, each driven by a separate motor of Electromotors, Ltd.,



Electric Motor Direct-driving a Large Press.

make; at Messrs. Furnival's stand, are also large presses in operation, driven by slow-speed motors, supplied by this firm, as illustrated above. The Electromotor productions are all standard, and we gather that they are meeting with increasing success in the trade.

The Union Electric Co., Ltd., of 151, Queen Victoria Street, have a large and representative exhibit, comprising electrically-driven machinery, the latter consisting of box-making plant shown by Messrs. Andrew & Suter, 23, Goswell Road, E.C., who share the stand; various types of "Union" motors, motor-starting and controlling apparatus, "Union" switchboard instruments and testing sets. The firm has also an excellent display of electric lighting apparatus, including the "Union," "Excello" flame, enclosed and miniature arc lamps, among which the "Excello" takes a first

Union Arc Lamp with Semi-opaque Cover for Semi-indirect Lighting.

place for outside work and the miniature type for window and inside work generally. For printing works and showrooms, the inverted and indirect lamps, shown in operation, are specially suitable—and the exhibit also includes arc lamps for photographic and similar purposes.

*(To be continued.)*

**Spanish International Telephones.**—It is proposed to establish a new International telephone line between Madrid, San Sebastian, Barcelona, and Paris.

## PARLIAMENTARY.

### Belfast Tramways Bill.

The Belfast Corporation Tramways Bill was commenced before a Select Committee of the House of Lords, presided over by Earl Camperdown, on Thursday, 28th ult. Mr. J. D. Fitzgerald, K.C., and Mr. Harrison represented the promoters, and the opposition was represented as follows:—The Belfast and County Down Railway Co., by Mr. Ronen, K.C., Mr. A. H. Bates and Mr. Andrews; the Great Northern Railway Co. of Ireland by Mr. Claude Baggallay, K.C., and Mr. Vesey Knox. The Midland Railway Co. and the Belfast Street Tramways Co. reserved counsel.

Mr. J. D. Fitzgerald, in explaining the Bill, said the first object was to enable the Corporation to acquire the undertaking of the Belfast Street Tramways Co., and the second to authorise the construction of additional tramways for the development of the system. The terms of acquisition had been agreed upon, and there was no opposition from the company. Although the Tramways Act of 1870 did not apply to Ireland, special provisions were included in the Belfast Tramways Act of 1872, giving the Corporation power to purchase at certain specified periods. These powers of purchase became exercisable in 1893, but a fresh agreement was then arrived at between the parties by which the powers of purchase were deferred until 1907. At that time, however, the spread of electric traction was not foreseen, and as the result of the agreement, Belfast was now the only important town in the United Kingdom which was served only with horse tramways. The Belfast Co. did obtain powers a few years ago to work electrically, with the consent of the Corporation, and negotiations had taken place with the object of bringing about an electrification of the tramways. Difficulties, however, arose as to terms, and ultimately it was considered better that the Corporation should take over the system at once, and thus accelerate the period of purchase. An arrangement had been come to, and the system of the company would be taken over on January 1st. There were other tramways in Belfast owned by the Corporation, and it was proposed to make an efficient service for the city. The only opposition came from two of the three railway companies having termini in the city, and the objection was on the ground of competition.

Mr. Vesey Knox said the Great Northern Co. objected to a number of clauses in the Bill. They did not oppose the principal object of the Bill which was to give the Corporation power to electrify the tramways.

Mr. Ronen said the objection of the County Down Railway Co. was not to the proposal for really town tramways, but they objected to the clause enabling the Corporation to take over and manage tramways outside the borough.

A number of witnesses were called in favour of the Bill, including Mr. M'Cormick, chairman of the Law Committee of the Belfast Corporation, who denied that there was any intention on the part of the Corporation to run the tramways at a loss.

In cross-examination by Mr. Baggallay, Witness admitted that the Bill was so framed that it would be possible for the Corporation to take over and work electrically systems of tramways extending far beyond Belfast without coming to Parliament, but there was no intention on the part of the Corporation to do this. The Bill enabled them to work a line not belonging to the Belfast Tramways Co., which ran into the city past the Cavehill, and they did intend to exercise their powers in respect of this tramway.

Answering Mr. Ronen, Witness said the Bill gave the Corporation power to acquire the Holywood tramway within the City, which was to be proposed in another Bill, and to work the whole line to Holywood.

Mr. Baggallay asked the Committee to throw out Clauses 26 and 41, these being the clauses which would enable the Corporation to supply electrical energy outside the city boundary, and would enable them to take over and work tramways without the city boundary. He would not oppose any arrangement for the Cavehill tramway, and would therefore ask that the clauses be made to apply only to the existing tramways.

The Chairman said he took it that what Mr. Baggallay wanted was that the Corporation should be obliged to come to Parliament in the event of their wishing to run 15 or 20 miles outside the City.

The Committee decided to pass the preamble of the Bill, and proceeded to consider clauses.

In Clause 26 Mr. Harrison said the Corporation had their own electric light works, and it was proposed to develop those works so as to supply energy for tramway purposes. They desired to supply electrical energy for traction to anyone who would take it from them.

Mr. Baggallay asked that the clause should be limited so as to limit the power of supply to tramways existing at the passing of the Act.

Mr. Mitchell, electrical engineer, examined for the promoters, said the Corporation could not lay mains outside the borough, and therefore they could only take the energy to the boundary and allow the purchasers to deal with it in their own way. He saw no reason why the Corporation should not be allowed to supply energy for the Holywood tramways.

The Committee decided to limit the clause in the way proposed by Mr. Baggallay.

Mr. Baggallay also proposed to limit Clause 41, which gave the Corporation power to enter into agreements for the working of any tramway outside the borough in a similar way.

After consultation, the Committee struck the clause out of the Bill. Other clauses were adjusted, and the Bill was ordered to be reported for third reading.

### L.C.C. Tramways Bill.

On Wednesday, May 4th, evidence in opposition to the tramway was called. Superintendent Bantick and Sub-divisional Inspector Monk, the officer in charge of the police station in Tottenham Court Road, both considered that the tramway would greatly impede the traffic. Mr. J. W. Willoughby (the Mayor, Holborn), Mr. C. Fitzroy Doll, architect, and other witnesses also gave evidence in support of the opposition. Witnesses in support of the opposition of the frontagers were then called.

Mr. H. G. Regnart, director of Maple & Co., Ltd., considered that the tramway would not only add to the congestion of the traffic, but would diminish the value of the property in the thoroughfare. The tramway would be of no value to Messrs. Maple; it would impede access to their premises.—Mr. F. T. Shoolbred, of Messrs. Shoolbred & Co., said that the tramway would have a serious effect on his company's business, as it would tend to discourage carriage traffic.—Mr. A. Heal, of Messrs. Heal & Sons, gave similar evidence.

Mr. W. N. Blair, the engineer and surveyor to the St. Pancras Borough Council, was then called, and, after stating that he wished to be excused from giving his own opinion on the matter, said that the Borough Council which he represented was now in favour of the tramway. His evidence before the Traffic Commission was the opinion of the old Borough Council; a new Council had been elected since.

Lord Robert Cecil, K.C., in addressing the Committee on behalf of the frontagers, contended that no public case had been made out for the proposed line. That most important of evidence in support of a tramway, the evidence of workmen who desired a tramway to get to and from their work, was entirely absent in this case. No doubt the St. Pancras Borough Council wanted the widening of Hampstead Road, and that was their main object in assenting to the Bill. Sir Ralph Littler, K.C., on behalf of the Charing Cross, Euston and Hampstead Railway Co., having addressed the Committee, Mr. Erskine Pollock replied for the London County Council.

The Committee deliberated in private, and when parties were re-admitted to the room, the chairman announced that the Committee were prepared to sanction the line so far as Francis Street, and a single line beyond Francis Street, so long as it did not interfere or obstruct the entrance to any side street; the Committee could not sanction any line further than that, and the line was sanctioned only on condition that no horse trams were to be used, and that the line should be worked electrically. It was only fair to say that the Committee were not unanimous in their decision.

On May 5th the Committee considered the proposal to extend the tramway from the terminus at Waterloo Station to the corner of the York Road.

Mr. Erskine Pollock, K.C., said that the line would be 1 furlong 7·3 chains in length. At the proposed new terminus the road was 48 ft. wide, while at the existing terminus it was only 44 ft. 6 in. The cost of the proposed extension would be £3,500. It would take passengers nearer to Waterloo Bridge, and would, therefore, be of considerable public advantage. The Council had endeavoured as far as possible to bring the trams nearer to the bridges on all the southern lines. There was some opposition to the scheme from some frontagers, but the most serious opposition was that of the London and South-Western Railway Co. The company contended that the proposed tramway would be dangerous on account of liability to collision between the cars and omnibus and other vehicles coming down the slopes from the station.

Mr. Maurice Fitzmaurice, engineer to the Council, was called, and questioned as to the contention of the railway company, said that in his opinion it was absurd to suggest that there was any danger.

Other witnesses having been called in support, Mr. H. Holmes, traffic superintendent to the company, gave evidence in support of the opposition. The Committee, having conferred, found that that part of the preamble had not been proved.

On Friday, May 6th, Tramways Nos. 4 and 10 were considered.

Mr. Erskine Pollock said that Tramway No. 4 would be a double line, 1 mile 3·18 chains in length. It would commence in the East Dulwich Road, by a junction with a tramway already authorised but not yet constructed, and passing the route of the disused line of the Dulwich and Camberwell Co. for a distance of some 17 chains, would end at Peckham Rye, near Stewart's Road. The total cost would be £42,050. The consent of the local authority had been obtained, and although the statutory width could not be given throughout the whole length of the route, an arrangement had been made with the Camberwell Council to set back the railings along part of the Rye. Tramway No. 10 would begin in Lordship Lane, by a junction with a line authorised in 1902, and would end almost opposite to Forest Hill Station. The line would be a little over 1¼ miles in length, and the cost was estimated at £51,000. Widenings and paving would cost another £21,250. The Committee adjourned.

### Royal Commission on London Traffic.

On Thursday, May 5th, evidence was given by Mr. Philip Dawson, M.Inst.M.E., M.I.E.E., &c. He said that he held the position of consulting electrical engineer to the London, Brighton, and South Coast Railway Co., and had acted as engineer to a large number of traction and power undertakings. He divided London traffic into "local traffic" and "through traffic." Local traffic was traffic between points within the Metropolitan area, while through traffic was traffic between London and the suburbs. Local traffic could best be served by surface lines, and through traffic by the electrification of the railways. One great source of trouble to those railways possessing a heavy suburban traffic was the present inadequacy of their terminal facilities. The matter was a

difficult one to deal with, but he suggested that an improvement might be effected by decentralisation, or the dividing of traffic more evenly between the different termini. Witness went into the details of what had been done in this direction by the various railway companies. The construction of special termini for local traffic only might be considered in some cases, where it would be possible, if expensive, to contruct an underground station and physical junction with the District Railway. He believed that such a station had proved very satisfactory at Boston, U.S.A. At Victoria it might be possible to construct underground subways for tramways, and the same idea was applicable to other stations. It might be possible for trains coming through tube lines to come out into the open and run over other lines, thus effecting a through service. There was a difficulty in the way of that, however, in the fact that the tube lines and the Metropolitan District Railway had adopted a continuous-current system which necessitated a third rail and, sometimes, a fourth rail. Investigations made in connection with a report which he was preparing for the directors of the L.B. and S.C. Railway, convinced him that if electric traction was to be generally introduced on existing railways, those additional rails, one of them alive, could not be installed. The only possible system was one requiring not more than one overhead conductor per track, or, in other words, the single-phase, high-tension, alternating-current system. Single-phase motors had recently been designed, and were being manufactured, which were perfectly adapted to traction work, and could give results which appeared to be quite as satisfactory as those obtained with continuous-current motors. He considered the electrification of the suburban system of railways was necessary. It would give greatly increased facilities, and would have the following advantages:—Increased average speed, including stoppages; decrease in cost of operation and greater comfort to the public. Witness went on to compare the cost of working railways by steam and by electricity. Whereas steam engines consumed a large amount of fuel for which no work was done, electric trains consumed no energy except whilst working. Steam locomotive costs were proportional to the train mileage, but with electric trains the cost was in proportion to the ton mileage. If railway companies electrified their suburban systems, electric tramways, instead of hindering them, would actually help them, by acting as feeders. The introduction of electric traction on suburban lines would result in doubling the carrying capacity. Again, the wear and tear of the permanent way, particularly at junctions, would be reduced by electric traction, owing to the absence of oscillations due to the present driving mechanism, and the smaller weight required upon the driving wheels. For the same weight on the drivers, an electric motor could exert a much greater tractive effort than a steam locomotive, because the electric motor exerted a constant "torque" upon the driving axle, while a steam engine did not. The cost of operating an electric train could be reduced by having only one man in charge of the motor. He considered that the Board of Trade ought to take no objection to that, as the methods of control used were such, that the current would be immediately and automatically cut off and the brakes applied, if the driver were incapacitated in any way. Moreover, the men required to operate electric trains need not be mechanics or trained men. Native intelligence was all that would be required. The system of electric traction that would be most advantageous would be that system which could be applied to the main lines.

Mr. S. B. Cottrell, M.Inst.C.E., &c., engineer-in-chief and general manager of the Liverpool Overhead Railway, described the working arrangements of that system. He considered that for urban traffic, overhead railways should be constructed where there were back streets, and where their unsightly appearance would not matter and compensation would not be likely to be so serious. Unfortunately, such streets were difficult to find in London, and therefore communication would have to be by shallow subway railways and deep level railways. Shallow subways could not be constructed in some cases owing to the nature of the subsoil.

Mr. H. E. Jones then gave evidence at some length on behalf of the Gas Companies' Protection Association.

On Friday, Mr. G. F. L. Foulger, distributing engineer of the Gas Light and Coke Co., gave evidence. He agreed that it was a fact that during the past 10 or 12 years, the streets of London had been seriously disturbed by ground openings. Without in any way whatever desiring to cast blame on any other companies having statutory rights as to the manner in which those rights had been exercised, he thought he might fairly call attention to the fact that the obstructions had been very largely caused by those companies and bodies who, within this period, had been engaged in laying down through practically every road and street in London their distributing plant for the first time. He alluded to the various electric lighting companies and borough councils supplying energy, as well as the underground telephones recently laid down by the Post Office authorities. He would not object to doing work when the local authority opened the street for repaving, and being afterwards prohibited for nine months from again interfering with the streets, unless there was good reason shown for doing so to the satisfaction of an independent person.

Prof. A. B. W. Kennedy, vice-president I.C.I., and engineer-in-chief to the Westminster Electric Supply Corporation, said that, along with Mr. Conacher, the general manager of the Metropolitan Electric Supply Corporation, he had been asked to give evidence on behalf of the following electric undertakers in London:—Blackheath and Greenwich Co., Brompton and Kensington Co., Charing Cross and Strand, Chelsea, City of London, County of London and Brush Provincial, London Electric Supply, Metropolitan Electric Supply, Pall Mall and St. James's Co., and the Westminster Electric Supply. He had been asked by the secretary of the commission to give evidence under five headings. The first was as to the authorities to whom application was at present to be made in respect of the breaking up of the streets for electrical purposes. [With this point Prof. Kennedy dealt at considerable length, but, unfortunately, the space at our disposal will not allow us to give his evidence fully.] Various witnesses had suggested the use of subways as a means for getting rid of the opening up of the streets. He thought that most of these witnesses had not fully realised the nature of the problem. The use of subways, even when practicable at all, was absolutely restricted to a few very important thoroughfares, whereas the electrical mains covered practically all the streets in the district. The work of all electrical undertakers came first under principal streets, and, therefore, was long ago practically finished just in those streets where subways might be laid. Two kinds of subways had been proposed by witnesses before the Commission. The first was the L.C.C. type of subway, which was at present used in Northumberland Avenue, Charing Cross Road, Shaftesbury Avenue, &c. He had personally examined several of these subways, and thought there was very great danger in putting electric light mains and gas mains within the same very limited space. In the event of an accident to the main occurring at a time when there had been a leakage of gas, an extremely dangerous explosion would result. On the other hand, if any mechanical accident occurred which broke a gas main, it would be at the same time very likely to damage the electrical mains so as to cause an arc, and in that case there would be an exaggerated version of the Piccadilly fire at Walsingham House. He believed a number of serious accidents had already occurred. In considering this or any other type of subway, he did not think that it had ever been realised what a very large amount of space was actually required for the electrical mains alone, nor what a very large actual value in money they represented. He had himself in use in Edinburgh a subway for electrical mains only from one station, this subway being specially constructed for the purpose, and being 6 ft. 6 in. high and 3 ft. 6 in. broad (inside). It was designed to take nothing but the cables or copper from one station only, a station not so large as, for example, the Bankside station of the City of London Co. It was quite impossible to find within a subway of the L.C.C. pattern anything like the room for the large quantity of electric mains, in addition to water and gas pipes and hydraulic power mains. It might also be interesting to the Committee to know that the actual value of the mains or cables laid along the principal thoroughfares by several London companies was between £50 and £100 per yard of route. The Council of the City of Westminster had suggested the use of subways extending from cellar to cellar and large enough to provide for tramways, foot passengers, and pipes as well. No doubt if the electrical mains under this arrangement could be placed close to the cellar wall, the difficulty of opening up the streets overhead to make services would be overcome. The question of danger, however, not only remained, but was seriously increased. It was not necessary for him to say anything to the Committee about the extreme difficulty of making such a subway and its enormous expense, however desirable for other purposes; but he must point out that the financial aspect of it, so far as concerned the electrical undertakers, had been entirely (although, no doubt, unintentionally) misrepresented by the local authority. The City of Westminster authorities gave evidence, for instance, that £30,000 was expended annually by the electric, gas and water companies in their district in road work. It was admitted that the electrical companies could not be asked to remove the existing mains at their own expense, but it was suggested that the saving of road work to the electrical undertakers would be so great that they might pay a sufficient sum per annum to the City of Westminster as rent, and yet spend no more than they did at present. He could not speak for other companies than the Westminster Co. in this matter; but he had to say that, although the actual sum spent during 1903 by the Westminster Electric Co. on road and pavement work for the whole district was about £6,000, only about £120 of this was expended in the particular 4 miles of road under which conceivably the City of Westminster might construct subways. The work of the electrical undertakers in these principal streets was finished years ago, and the only additional work carried out in them was the making of house services. New feeders had been repeatedly laid by the company, but in all cases where possible had been laid in streets where the inconvenience of opening up would be comparatively little. He understood that the state of affairs in other districts was very much the same, and he therefore thought that, although enormous sums would necessarily be expended by the City of Westminster in putting new mains for them into the subway and making the new connections to the consumers, the actual saving to the company as compared with their present work along the streets in question would be practically *nil*. He thought that if the whole of the borough authorities would—as a considerable number of them actually did—recognise that electrical and other undertakers had not only statutory powers, but statutory obligations, and would deal with them on this basis, a great deal of the inconvenience even under the present system would disappear. As to the practicability of providing one central authority to regulate the breaking up of streets throughout London, after full consideration of this question by the electrical undertakers, they did not think the creation of a central authority would be desirable in itself, or of use to the public. Nearly all the work which was done now by electrical undertakers has to be done somewhat quickly at the time when it was done, the exception being heavy work which could be foreseen, and the time for which could be, and generally was, arranged with the local authority. What appeared to be really wanted was that there should be such co-operation between local and public authorities and the undertakers. He thought that the system of reciprocal fortnightly notices suggested would help very materially in this matter, but the appointing of one central authority above all the city and borough councils would tend to delay and difficulty, rather than to the increase of public convenience.

So far as electrical companies were concerned, they thought that the authorities with whom they had to deal, should be the City and borough councils, and not the London County Council, and that there should be an appeal from either side to the Board of Trade as at present. Nightwork has been suggested by some authorities. As to this, he would point out in the first place, that *services* could not be laid at night, neither could any work be done which involved access to consumers' premises.

Replying to Sir JOHN WOLFE BARRY, WITNESS said that as the different districts were being served, the number of openings would be less and the figures of the last few years could not be taken as the figures of the future.

Mr. JOHN CONACHER, general manager of the Metropolitan Electric Supply Co., said his company's system extended into four of the municipal areas of London, viz., Paddington, Marylebone, Holborn, and Westminster, but the practice with regard to reinstatement of streets varied throughout those areas, and he believed that the inconvenience complained of, from delay in the permanent re-instatement by local authorities of both footways and roadways after they had been opened by supply companies, could be greatly lessened by the extension and general adoption of an arrangement which existed with regard to the whole of Paddington and part of Holborn, between the Metropolitan Co. and the Borough Councils concerned. In Paddington, the Borough Council allowed the company to permanently re-instate all footways after mains, other than service connections had been laid, and also all roadways, except where they were paved with wood. Similar arrangements could be extended to the whole of London with advantage to the public, and without any loss to the boroughs, and at the same time no doubt money would be saved to the companies. Witness agreed with Dr. Kennedy in anticipating considerable advantage from the mutual notification to each other by all local authorities and undertakers having power to break up streets, of their intention to carry out works of any considerable extent. He considered London too vast to make it practicable to set up a central authority for the regulation of all breaking up of streets. The Metropolitan and the Charing Cross and Strand Companies, who had considerable experience of the placing of electric mains in subways, viewed with great apprehension the placing there together, of gas and electric mains. If an accident happened which injured both kinds of mains, they believed the consequences would be very serious.

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### NORTH WALES ELECTRIC POWER BILL.

THE Select Committee of the House of Lords, of which Lord Clifford of Chudleigh is chairman, had this Bill under consideration last week.

Mr. BAGGALLAY, K.C., in opening the case for the promoters, said that the Bill was to authorise the North Wales Electric Power and Traction Co. to utilise the waters of the Llyn Llydaw, on the eastern slopes of Snowdon, for the purposes of generating electricity. They desired further to use that energy for power purposes over an area which included the counties of Carnarvonshire, Merionethshire, and Anglesey, a small portion of the County of Flint, and a considerable portion of the County of Denbighshire. In Flint were included the towns of Rhyl and St. Asaph. The primary object of the Bill was the supplying of electrical energy to some narrow gauge and light railways, authorised in 1901, the supplying of energy to the Beddgelert and Creosor Railway Co., and also to certain authorised electrical undertakings within the scheduled area of supply. Coming to a consideration of the works proposed, counsel said that a dam would be constructed to raise the water of the Llyn Llydaw to a height sufficient to get a good fall to the power house. The water level would be raised some 20 ft., which would make the fall some 1,150 ft. He mentioned several cases where water power had been used for the generating of electrical energy. The light railways would, by the Bill of the South Snowdon, Portmadoc and Beddgelert Railway Co., be transferred to the power company which was already incorporated. Counsel then detailed the negotiations which had taken place. It appeared that the Portmadoc and Creosor Railway Co. was authorised by their Bill, 1901, to supply a very small area of the district with electrical power in bulk. The company, however, had got into financial difficulties, and had negotiated with the Northern Counties Traction Co. That company, having considered the project, had come to the conclusion that the water power available was good, and could be relied upon. They considered that it warranted a bigger scheme, however. The North Wales Electric Power and Traction Co. was, therefore, formed, and a prospectus was issued in 1903. Some 50 shareholders took 34,000 shares of the value of £170,000. Arrangements were then made with certain gentlemen who had rights in the waters of Llyn Eigian, and these gentlemen were acting as promoters of the present scheme. The capital of the North Wales Power and Traction Co. was £270,000, with power to issue £135,000 debentures. The outcome of the negotiations was that it was arranged that the promoting company should carry out the scheme of the South Snowdon, Portmadoc and Beddgelert Railway Co., and a large portion of the work was now being constructed. It was estimated that the power obtained from the water would equal 12,000 H.P. About 1,000 H.P. would be used by the railway, and the remainder would be available for other purposes. The cost of the hydraulic work was estimated at £4,500. The pipe line to the power station would cost £16,000, and the power station itself would cost £36,000. The transmission lines would take £21,000 and land £8,750, making a total of £86,500. £40,000 had been paid for the private undertaking in the north, so that the total expenditure would be £126,500. There were three classes of opposition to the Bill; the first was to the proposal to transmit power by overhead wires. The Board of Trade would have power to modify the proposal. The County Councils wished to have a veto in the matter, and to that the promoters objected. The next class of opposition was that which contended that it was undesirable to grant such powers as were proposed to a limited liability company. He considered that there was little in that objection, for, curiously enough, the only really successful undertaking was that of a limited liability company—the Newcastle-upon-Tyne Electric Supply Co. Then there was the question as to the supply of energy for power and lighting. The Bill included the usual clauses as to the supply to authorised undertakings and for power purposes. Current was only to be used for lighting upon premises where a supply of energy was taken for power purposes. Many of the petitioners desired an absolute veto, but the promoters desired to have the usual clause. With regard to the opposition of the Carnarvon Corporation, he was afraid that the promoters were in a somewhat peculiar position. The Corporation had entered into an agreement with the National Electric Construction Co., but when the Local Government Board inquiry was held, the inspector refused to grant the loan, as he considered that the Corporation would do better to take energy from the present scheme. [Counsel for the Corporation denied this.] Continuing, Mr. Baggallay said that, although the Corporation was willing to take a supply from the promoters, the Electric Construction Co. were bringing an action against the Corporation for breach of contract.

Mr. RAWLINGS, the chairman of the promoting company, having detailed the negotiations between the various companies, said that a contract had been entered into with Messrs. Bruce Peebles and Co. to erect the first power station and carry out certain other works for the sum of £145,000. The restrictions with regard to transmission by overhead wires had had a very prejudicial effect on the electrical enterprise in Great Britain. In cross-examination, the witness would not agree to omitting Llandudno, Rhyl and other towns from the scheme.

Mr. S. Z. DE FERRANTI, consulting engineer to the scheme, was called. He considered the conditions very favourable, as the cost of utilising the water would be very low. He was satisfied that 12,000 H.P. would be available. Upon the assumption that there would be a 25 per cent. load factor, the net sales of electricity would be more than the 12,000 H.P. The use of overhead wires was the only method which would give a proper financial result for a scheme of that kind. He mentioned various cases where overhead wires for power supply had been successfully used. Many years ago a large portion of the City of London was lighted by means of overhead wires. It was found that during a heavy snowstorm the electric mains stood, although the telephone and telegraph wires were blown down. The reason was that the heat of the electric light wires, due to the heavy currents, prevented snow freezing on them. The cost of the overhead wires for the present scheme he estimated would be £600 per mile.

A number of local witnesses having been called, Mr. A. A. C. SWINTON gave evidence in support of the scheme. He said that the Board of Trade had sanctioned the use of overhead wires in the Stroud Valley. Overhead wires permitted higher pressures than did underground cables. Mr. HARPER, Harper Bros. & Co., engineers to the scheme with Sir Douglas Fox and partners, then spoke as to the water power.

On Friday the Committee heard speeches from counsel in opposition to the Bill, and having conferred in private, found the preamble of the Bill proved.

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### ELECTRIC LIGHTING PROVISIONAL ORDER (No. 2) BILL.

THE Electric Light Provisional Order No. 2 Bill which confirms Provisional Orders relating to Bath Rural District, Brynmawr, Chippenham, Eastleigh and Bishopstoke, Hanwell, Southgate Urban District, Tamworth, Walton-le-Dale, Watford and Widnes (amendment) has been before the Examiner and Standing Orders have been found to have been complied with.

The Colney Hatch Gas Co. have given notice of opposition to the order being confirmed to the Southgate U.D.C., and the Tamworth Gas, Light & Coke Co. are opposing the Tamworth Order, and the Watford Gas Co. the Watford Order.

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### ELECTRIC LIGHTING PROVISIONAL ORDER (No. 3) BILL.

THE third Provisional Order Bill confirming electric lighting orders granted by the Board of Trade has been found by the Examiners to have complied with Standing Orders. The Bill deals with the following orders:—Order to enable the Birkenhead Corporation to extend their area of supply to the townships of Prenton and Upton; order amending the Bishop Auckland Order, of 1900, and substituting the County of Durham Electrical Power Distribution Co., Ltd., for the Urban Electric Supply Co. as the authorised undertakers; order enabling the Huddersfield Corporation to extend their area so as to include the Urban District of Golcar; order authorising the Corporation of Maidenhead to include the Parishes of Taplow, Hitcham, and Burnham, and the Eton Rural District, in the County of Bucks, and the Parishes of Cookham and Bray, in the County of Berks, in the area of supply; provisional order granted to the Milford-on-Sea Electric Supply Co. in respect of the Parishes of Milford and Hordle, in the County of Southampton; order granted to Henry Foote, Leonard Milne, and Edward John Owen, trading as the Southern District Electricity Corporation, of 66, Victoria Street, Westminster, in respect of the Urban District of Newquay, Cornwall; order granted to the Penzance and District Electric Supply Co., Ltd., for the Borough of Penzance; order granted to the Ramsgate and District Electric Supply Co., Ltd.,

whose registered offices are at Broad Sanctuary Chambers, Westminster, in respect of the Borough of Ramsgate; order granted to the County of Durham Electrical Power Distribution Co., Ltd., in respect of the Urban District of Southwick-on-Wear, the Rural District of Sunderland, and the Rural District of Houghton-le-Spring; order granted to the Tavistock and District Electric Supply Co., Ltd., whose registered office is York Mansion, Westminster, in respect of the Urban District of Tavistock, Devon.

The Maidenhead Gas Co. has deposited a petition in opposition to the Maidenhead order.

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RADCLIFFE TRAMWAYS AND IMPROVEMENTS BILL.

THIS Bill came before the Police and Sanitary Committee of the House of Commons on Monday.

Mr. WEDDERBURN, K.C., in opening the case for the promoters, said that part 2 of the Bill dealt with tramways, and part 4 with electricity supply. It was proposed to construct certain new tramways in addition to those lines authorised by the Radcliffe Tramway Act of 1900. The tramways authorised in 1900 had not, in accordance with the Tramways Act of 1870, been commenced within a year and completed within two years of the passing of the 1900 Act. An agreement had been come to with the Bury Corporation, however, as to the working of the whole undertaking. The undertaking would be leased for 30 years. The permanent way would be constructed by the Radcliffe Urban District Council, and the Bury Corporation would electrically equip and work the lines. Powers were also sought to supply electrical energy to tramway undertakings adjoining Radcliffe. The cost of the whole of the lines would be some £79,300, and it was proposed to spread this over 30 years. Part 4, under clause 45, of the Bill empowered the District Council to supply electrical energy in bulk to authorities outside the district. The Lancashire Electric Power Co. petitioned against clauses 45 and 46. An application for a supply having been received from the Whilefield District Council, the Radcliffe Council wished to be in a position to supply in bulk. He contended that the Lancashire Co. had no monopoly in the area.

Mr. BAGGALLAY, K.C., addressing the Committee on behalf of the Lancashire Power Co., said that a clause similar to that proposed had been struck out of the Willesden and Wood Green Bills last year.

Mr. WEDDERBURN having replied, the CHAIRMAN announced that the Committee had decided to limit the operation of clause 45 to two small portions of the Rural District of Bury, but the clause was not to apply to the Urban District Council of Whilefield.

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*Lancashire and Warwickshire Electric Power Bill.*—This Bill was on May 5th before the Unopposed Bill Committee of the House of Lords, and the preamble was formally found proved. The Bill extends the periods limited by Section 67 of the Act of 1902 for making a substantial commencement of the works, and repeals Section 21 which has reference to the company exercising the power of borrowing on capital before the whole is paid up; it also allows generating stations to be erected on lands other than those scheduled in the Act of 1902.

*Bournemouth Corporation Tramways.*—The Bournemouth Corporation Bill came before Lord Morley's Committee of the House of Lords on May 5th, and was ordered to be reported for third reading. The object of the Bill is to enable the Corporation to construct and work tramways in Bournemouth and Christchurch, which shall form part of the existing undertaking. Borrowing power is taken for £39,000 for the proposed tramways, and a sum for the purchase of land and the bridge over the Stour.

*Electric Lighting No. 1 Bill.*—On Friday the Electric Lighting Provisional Order No. 1 Bill came as an unopposed measure before the Chairman of Ways and Means in the House of Commons, and was ordered to be reported for third reading. The Bill confirms provisional orders in respect of Barry, Clitheroe, Gainsborough, Glastonbury, Heysham, Kirkby-in-Ashfield, Saffron Walden, Walmer, Whickham, and Yardley.

*London United Tramways Bill.*—On 4th inst. a number of local witnesses in opposition to the scheme having been called, Mr. Scott-Montagu, M.P., was called. He considered that if the line was sanctioned there should be either kerbing or guard-rails along the road, as the road not being properly lighted, would be dangerous by reason of the trolley poles if some such provision were not made. Other evidence having been given, the Committee, after private deliberation, found the preamble of the Bill proved, subject to the compliance of the company with the requirements of the Middlesex County Council as to width of road, surface drainage, kerbing, wood paving, and the lighting of cross roads. They fixed the purchase period at 25 years.

*Holywood Tramway Bill.*—A Select Committee of the House of Lords under the chairmanship of Lord Camperdown, considered the above Bill last week. The Committee found the preamble of the Bill proved, subject to a clause being inserted as to 9 ft. 6 in. being left on each side of the road where the line was single, and 9 ft. 6 in. on one side where the lines were double.

*Derbyshire and Nottinghamshire Electric Power Bill.*—On May 5th the Derbyshire and Nottingham Electric Power Bill was before Lord Morley's Committee of the House of Lords. The object of the Bill is to amend certain clauses of the company's existing Act to facilitate the raising of capital, and to pay interest out of capital. It also gives power to acquire the undertakings of local authorities and others. There was no opposition, and the Bill was ordered to be reported to the House.

*North-Western Electricity and Power Gas Bill.*—This Bill came before the Committee of the House of Commons, presided over by the Deputy Chairman, on Friday, and the preamble having been found proved, was ordered to be reported to the House. The Bill amends the Companies Act of 1903 in various particulars, and gives the company power to take over the undertakings of local authorities.

*Great Yarmouth Corporation Bill.*—The Omnibus Bill of the Great Yarmouth Corporation came before the Unopposed Bill Committee of the House of Lords on May 5th, and the Bill was ordered to be reported for third reading. The Corporation is seeking power to lay between 5 and 6 miles of additional tramway, and seeks borrowing power to the extent of £77,000 for tramway purposes.

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[*Correction.—Lothians Electric Power Bill.*—In our last issue (page 742) we stated that this Bill "will not be proceeded with." We regret that owing to our Parliamentary Committee representative having misread an official notification this inaccurate statement was made. The official notice was "That the Committee had not proceeded with the consideration of the Bill, *the opposition thereto having been withdrawn.*" As a matter of fact, there never has been any idea of the Bill being abandoned; indeed, since our last issue went to Press the Bill has been carried through further stages at Westminster.]

## LEGAL.

METROPOLITAN ELECTRIC SUPPLY CO., LTD., *v.* ST. MARYLEBONE BOROUGH COUNCIL.

THIS case was mentioned to Mr. Justice Buckley in the Chancery Division on Friday last, when the defendants applied for an extension of time until June 30th for performing their obligations under the judgement against them for the specific performance of their agreement to take over the electric lighting of the borough.

Mr. FLETCHER MOULTON, K.C., stated that the Bill now before Parliament would shortly be passed, and that the London County Council had agreed to the proposed loan. The defendants offered to pay £5,000 down and £5,000 on or before June 30th.

Counsel for the plaintiffs agreed to the proposed extension of time, and said that the plaintiffs were wishful to proceed amicably, but they called the Court's attention to the facts that since the last application for an extension of time they had spent large sums on the works which would be for the benefit of the defendant Corporation, and that the balance of the capital expenditure owing by the defendants amounted to £28,752, and it was anticipated that a further £10,000 would be expended by June 30th.

His LORDSHIP extended the time, the defendants paying the two sums they had offered to pay, that was to say, £5,000 down and £5,000 on or before June 30th next.

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MACARTNEY, MCELROY & CO., LTD., *v.* BRIGHTON CORPORATION.

IN the King's Bench Division on May 6th, Mr. Montague Lush, K.C., made an application to Mr. Justice Grantham with reference to the above case, which was recently tried before his Lordship and a special jury. The action was brought to recover from the defendant Corporation the sum of £16,000 for work done in connection with the laying of the first lines of electric tramways in Brighton. The jury returned a verdict by which they awarded the plaintiffs £14,621 7s. 2d. It was agreed that his Lordship should hear the legal arguments of counsel at some future date.

Mr. LUSH said he had seen Mr. Fletcher Moulton, K.C., who had been the leading counsel for the defendants in the action, and they were anxious, if his Lordship was willing, to argue the case on Monday, May 16th.

His LORDSHIP said he thought that date would be convenient to himself.

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TEECE *v.* CORLETT ELECTRICAL ENGINEERING CO.

AT the Wigan County Court on Tuesday last week, Judge Bradbury gave judgement in this action, which was a claim for £14 odd wages alleged to be due from the company. The plaintiff claimed on behalf of his son, one J. H. Teece, 23 years of age, who in July, 1902, became connected with defendants, being an apprentice picking up a knowledge of the business. While at work putting a small installation into a house at Newcastle, a piece of his chisel flew off and struck him in the left eye, and he was unable to work for a time. It was stated that in consequence of the accident the father incurred some £30 or £40 expenses with specialists and on other things. It was contended for the plaintiff that he was engaged at a weekly wage, and that he had had no notice, and the point was whether the defendant company were not obliged to give the claimant notice before they could escape responsibility. The defence was that the plaintiff, having by the accident become incapable of doing work, that in itself put an end to the contract, and therefore he (the plaintiff) could not sue for wages.

His HONOUR, according to a report of the judgement in the *Wigan Observer*, said the question was: What were the plaintiff's rights against his employers? One would naturally say that the Compensation Act would apply to such a case. Under that Act the plaintiff would have got half his wages, but as a fact, the Act did not apply. The plaintiff was not working on, in, or about his masters' factory, but at the time of the accident was working away on other premises, and the Act did not apply to such a case. The

plaintiff was advised to try to get his full wages outside the Act, which defendants said was absurd, as under the Act he would only have about half his wages, and if an injured workman could get full wages there was no need for the Act at all. At first sight (his Honour said) it did seem rather a startling proposition that a man was entitled to recover under these circumstances full wages, although under the Compensation Act he could only have got, if it applied, half of his wages, and it was from that point of view that the case was of some interest and importance. The question was whether plaintiff was entitled under the circumstances, and on the facts of the case, to recover his full wages during the time he was incapacitated. He (his Honour) found, first that the incapacity for work was of a temporary character and second, that no notice was given by the defendants terminating the contract of employment. He held that illness of a temporary character, causing temporary incapacity to work, did not put an end to the contract. There was a distinction in law as between disease causing permanent and total incapacity, and injury causing merely temporary incapacity. In the case of a man struck by paralysis, which would permanently prevent him doing any more work, it was held that that would put an end to the contract, but he repeated that temporary illness and temporary incapacity did not put an end to the contract of employment. Consequently, he held that the contract, not having been determined by incapacity or by notice, remained in full force, and there was no suspension of the weekly payments by reason of the plaintiff's illness and inability to work. The result was that the plaintiff, in his judgement, was entitled to his full wages for the period sued for 11 weeks at £1 a week. It must be said that it was hard on the masters, that although the servant was not able to work he should be compelled to pay full wages. The answer to that was that the master had the remedy in his own hands. He could give the week's notice which was required, and the liability ceased. The payment was for 11 weeks' wages at 23s. a week, but the 3s. was an extra allowance for expenses, and the plaintiff was not entitled to that.

Judgement was therefore entered for the plaintiff for 11 weeks at £1 a week, and costs. The usual stay of execution was allowed, and leave to appeal was granted.

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### Campion *v.* Mossman Slander Action.

At the Leeds Assizes last week, before the Under-Sheriff, Mr. Edwin Gray, a jury sat to assess damages in an action for slander brought by Mr. Robert Harry Campion, electrical engineer for the borough of Dewsbury, against Mr. Theophilus Stanley Mossman, traveller, of Aldred Road, Sheffield. Mr. H. A. Hughes, of Dewsbury, appeared for the plaintiff, and Mr. Arthur Willey defended.

According to the *Yorkshire Daily Observer*, the defendant represented an oil company which formerly supplied oil to the electric lighting station at Dewsbury. In February of last year, some other oil being found more satisfactory, the officials transferred their patronage. It was alleged that the defendant thereupon developed malice against the plaintiff, and at the Sir Robert Peel's Arms, an inn opposite the electric lighting station at Dewsbury, he made a statement that the plaintiff was receiving a commission of 10s. per cask from the new company who were supplying the oil. This became town's talk, and a special meeting of the Electric Lighting Committee was held, at which it was abundantly proved that the charge against the plaintiff was baseless.

Mr. Willey made an unreserved apology on behalf of the defendant.

The jury assessed the damages at £12.

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### National Electric Traction Co., Ltd.

This matter was again before Mr. Justice Buckley in the Companies' Winding-up Court on Tuesday.

Counsel stated that the debt of the petitioners, Messrs. Hargreaves & Joblin, having been paid, he asked leave to withdraw the petition. This was agreed to; but another creditor supporting the petition, and represented by Mr. Cannot, was ordered to be substituted for the first petitioners, the petition to come on next week.

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### The Assessment of Electric Tramways.

A Divisional Court, consisting of the Lord Chief Justice, Mr. Justice Wills, and Mr. Justice Kennedy, in the High Court of Justice on Monday last, in the case of the New St. Helens and District Tramways Co., Ltd., *v.* The Assessment Committee of the Prescot Union, heard an appeal against a poor-rate made on June 12th, 1902, on their land and tramways in St. Helens. The appeal was to the General Quarter Sessions for the county of Lancaster, but by the assent of all parties a special case was agreed for the opinion of the High Court.

Mr. W. C. Pyke appeared for the appellants, Mr. A. Glen, K.C., and Mr. Rigby Swift for the respondents.

It appeared from the special case that the appellants were rated for land and tramways, 10 miles 44 chains, at a gross estimated rental of £3,165, and a rateable value of £2,110. The defendants are lessees from the Corporation of certain tramways owned by the Corporation, and worked by electrical power. The generating station, cables, wires, poles, &c., had been provided by the Corporation, and they also supplied electric power to other companies than the appellants, and also to the two pumping stations of the Corporation at Moss Bank and Peasley Cross, by means of the same equipment, and by means of subsidiary wires through which the appellants' cars derived their source of supply. The other parties, in addition to the Corporation pumping stations, were Broad Oak Colliery, Peter Tickle and Blartbrook Colliery, and such supplies were given through the wires without the knowledge or consent of the appellants, but after they became aware that the wires were being used by the Corporation for the purpose of supplying electricity to other consumers, they wrote to the town clerk of St. Helens calling attention to the fact that the cables which were laid for the purpose of the tramway system, were being used for supplying other companies, and asked what allowance the Electricity Committee proposed to make to the appellants. The reply was a resolution that "the tramways company be allowed an annual rebate of £3 in respect of such user." The quarterly accounts of the Corporation to September 30th, 1902, showed that an allowance of £5 was made to the appellants in respect of the supply of current to the Broad Oak Colliery Co. for 20 months, but no allowance was made in respect to the four other cases. No other persons than those named were supplied with electric power by the Corporation. The tramway posts were in some cases used for the purpose of attaching lamps to light the public highways, but the cables and wires for lighting the lamps were independent of those used for supplying power to the appellant's cars. The appellants had no control of the generating station, and all the equipment was kept in repair by the Corporation. On behalf of the appellants it was contended that they were not in occupation of the posts, cables, and wires, or any part of the equipment through which electrical power was supplied to the tramway cars. The respondents, on the other hand, contended that the appellants had, in fact, the exclusive and paramount control of the whole electric equipment; that the poles, wires, cable, and equipment were annexed to and formed part of the tramways, of which the appellants were rateable; and therefore the net annual value thereof ought to be taken into consideration in determining the annual value of the tramway and premises.

The question for the consideration of the Court was whether the appellants were rateable in respect of the posts, wires, cables, and equipment, and whether the net annual value thereof ought to be taken into consideration in determining the net annual value of the appellants' premises. If the Court decided in the negative, it was arranged that the rate should be amended as follows:—The gross estimated rental to be reduced to £1,500, and the rateable value to £1,000. If otherwise, the rate was to be confirmed, or the Court make such order as it thought fit.

At the conclusion of the arguments,

The Lord Chief Justice held that the Corporation, and not the appellants, were the occupiers of the poles, wires, cables, and equipment, and therefore the rate must be reduced to the sum stated in the special case to have been agreed upon.

The other judges were of the same opinion.

An application for leave to appeal was granted.

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### General Electric Co., Ltd., *v.* Fryer.

This case came before Mr. Justice Kekewich, in the Chancery Division of the High Court of Justice, on Tuesday. The action was brought by the General Electric Co., Ltd., against Mr. James Fryer, owner of 22 and 23, Garlick Hill, London, in what they claimed on a declaration that a lease granted to them by the defendant of the warehouses at Garlick Hill was no longer in force, on the ground that it had been properly determined by notice. The defendant counter-claimed for damages for breach of covenant to repair the premises.

Mr. Stewart Smith, K.C., for the plaintiffs, said the premises were leased for 21 years from September, 1896, at £396 rent. The lease was assigned on June 11th, 1900, to a company called Hands, Ltd, who paid rent to the plaintiffs. Plaintiffs thereafter handed the rent to the defendant. In September, 1902, Hands got into difficulties, and the Law Guarantee and Trust Society, who were the holders of a large number of Hands debentures, appointed an agent to take possession, but eventually Hands gave notice to the plaintiffs that they would determine the lease. The plaintiffs notified Mr. Fryer of that fact, and the defendant accepted the intimation by letter. The seven years under the lease did not expire till September, 1903, so that the notice given was a good deal longer than six months prior to that date, but on February 18th a compulsory order was made winding up Hands, Ltd., and the Official Receiver became liquidator of the company on June 22nd. After considerable correspondence, the defendant consented to receive the keys of the premises, but on October 16th he declined to take the keys, contending that the lease was not determined on September 29th, and would go on for the next seven years.

Mr. Lawrence, K.C., appeared for the defendant, and evidence having been called for the defence.

His Lordship dismissed the plaintiffs' claim, holding that the lease was not determined but still held good. The counterclaim was dismissed without costs.

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### Smith *v.* Pare.

This claim has been before the Courts in London this week. It is a claim by Dr. E. A. Cloete Smith, of Westbourne Street, W., to recover fees for professional services rendered to defendant's wife. Defendant contends that plaintiff's treatment (with X-rays and high frequency currents) was negligent, unskilful and useless. The case stood adjourned on Wednesday.

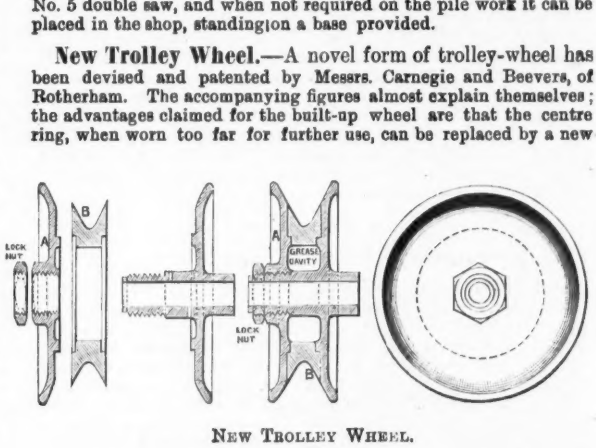
## BUSINESS NOTES.

**The Electric Elevators at the Savoy Hotel.**—The "Otis" electric elevator installation in the Savoy Hotel extensions is thought to be probably the largest electric elevator installation—both in point of number and capacity—in any hotel building in this country. The electric elevator service (apart from the powerful Otis hydraulic elevator installation in the old hotel block) will comprise seven electric passenger elevators, four freight elevators and 10 service elevators. All of the elevators are magnetically controlled; passenger and freight elevators from car only; and service elevators from the kitchen or main distributing floor. The car speed of the passenger elevators is about 300 ft. per minute (in one case 400 ft.). They have in most instances a lifting capacity of 14 persons. The magnetic control device is actuated in each case by a lever handle switch in the car. The two-speed device permits of the car being started from a floor on the slow speed until it has travelled a few feet, and being put back again to the slow speed when the car approaches the floor at which it is to be stopped, thus enabling easy and accurate stop with floor levels to be made. If a car is required to make only a short trip, or lady passengers prefer the slower speed, the car can be run at slow speed for its entire journey. A secondary or emergency switch is also provided in each passenger car, so that in the remote contingency of any derangement of the operating switch, by means of the secondary switch the car can be brought to a standstill at first or any desired floor; if it be allowed to run the full extent of its travel the speed is automatically reduced independently of the operator, as the car approaches either extremity and on reaching either limit of travel the car is automatically arrested. The latest and best known "Otis" car safeties are employed; the car is immediately arrested and firmly locked to the steel guides or runners in the event of overloading, breakage of a lifting cable, excessive downward speed from any cause, whether ropes are broken or intact, or undue stretching of a lifting cable. The landing gates or doors to each lift are provided with safety fittings to prevent the car being taken away from a floor with a gate left open, or a gate or door being opened unless the car is at the same floor level. The same care in the matter of operation and "safety" provisions has been bestowed upon the freight elevators, the lifting capacity of which ranges from 15 cwt. to 2 tons. The service elevators travel at the rate of 250 ft. per minute maximum. The magnetic control device is operated by a full set of buttons at the kitchen or distributing floor—the set of buttons for each lift comprises one for each floor served by car, with a "recall" button. Momentary depression of a button sends the car to a corresponding floor, the stopping being automatic. An electric signalling device is provided to indicate to the operator the whereabouts of any car, and the doors to the lift-well are provided with fittings to prevent the car being called away whilst it is being loaded or unloaded, and to prevent the door being opened except at that floor where the car is standing, thus preventing interruption of the elevator service by unnecessary opening of doors. The opening of a door is at once signalled to the operator.

**Colliery Installations.**—Messrs. Scott & Mountain, of Newcastle, have recently secured several important contracts, amongst others being a complete electrical pumping installation for the Consett Iron Co., Blackhill, an electrical pumping installation for the Weardale Coal, Coke & Steel Co., Croxdale, near Durham, and an electrical hauling and pumping installation for the Old Silkstone Colliery, near Barnsley. The plant for the Consett Iron Co. is required to deal with the water supply for the whole works. In order to economise water, the company are constructing large reservoirs below the works into which all available surplus water will be returned. These reservoirs are situated about 200 ft. below the upper part of the works, and the pumps are to be placed at the reservoirs. The pumps are of Scott & Mountain's well-known three-throw ram type, of special design, the rams being 18 in. diameter, and the stroke of the pumps 22 in. They are driven by three independent electric motors, each constructed to develop 130 H.P. on the brake at a speed of 500 revolutions. The motor will drive the pumps through cotton ropes, and both pumps and motors are arranged so that they will deal with the water at an increased head of 300 ft. if this should be required. The electric current for driving the motors will be supplied from two direct-coupled engines and dynamos, which will be placed near to the boilers, and about 1,000 yds. away from the pump house. Each of these plants will develop 550 B.H.P. The energy will be transmitted by overhead cables. The plant for the Weardale Coal Co. will deal with a large quantity of water at Croxdale Colliery, near Durham. The estimated flow will amount to about 1,200 gallons per minute, and in order to provide a margin of power, the plant is to be arranged with three sets of pumps, each of which will be capable of delivering 600 gallons per minute from the bottom of the shaft to the surface, the total head being about 650 ft. These pumps are to be of Scott & Mountain's three-throw mining type, and each is to be driven by a continuous-current electric motor of 140 H.P. The pumps will be placed close to the bottom of the shaft, and will all deliver into one rising main. The generating machinery will consist of a horizontal compound steam engine developing 600 H.P.; this engine will be fitted with a heavy rope fly-wheel grooved to receive the driving ropes. The Scott and Mountain generator will be of the continuous-current type, with double armature, the machine having a central driving pulley, this arrangement enabling either half of the machine to be worked independently if required. The total output of the generator will be equivalent to 530 H.P. The equipment of the Old Silkstone Colliery at Dodworth, near Barnsley, consists of a Scott and Mountain enclosed-compound high-speed engine capable of developing 220 B.H.P. coupled direct to a Scott and Mountain continuous-current dynamo having an output of 200 E.H.P. The underground plant consists of three electrical motors, two being of 10 H.P., and one of 25 H.P. The two 10-H.P. motors are for driving three-throw pumps, which will be placed in by and deliver water to the main pumps at the shaft bottom, and the third motor, *i.e.*, the 25-H.P. motor is for operating haulage gear at present driven by steam. In connection with this work, we understand that Messrs. Scott & Mountain hope to get most of it completed before they remove to the new works which they are building at Gateshead, where they will have a largely increased capacity and better facilities for carrying out their work.

**Novel Hack Saw Machine.**—Messrs. Beanland, Perkin and Co., of Leeds, have sent us an illustration of a novel hack saw machine, which they have just designed and made for a firm of contractors who are building a pier in the North. The machine has two reciprocating saws, and is worked by compressed air, by means of small high-speed engine attached, the motion being transmitted by means of machine-cut bevel wheels. It is being used for the purpose of cutting off level the ends of upright steel piles, section 10 × 8 × 75 lbs., after the piles have been driven in position. Previously the piles have been drilled off and then dressed with pneumatic chipping hammers. This machine is stated to do the work in a fraction of the time, and leave a much better job. The machine is provided with eye-bolts, by which it is slung from pile to pile as required, and it is clamped on by means of bolts and straps. The machine is an adaptation of the firm's No. 5 double saw, and when not required on the pile work it can be placed in the shop, standington a base provided.

**New Trolley Wheel.**—A novel form of trolley-wheel has been devised and patented by Messrs. Carnegie and Beevers, of Rotherham. The accompanying figures almost explain themselves; the advantages claimed for the built-up wheel are that the centre ring, when worn too far for further use, can be replaced by a new




New Trolley Wheel.

one at small cost, while the cavity round the central sleeve forms a grease chamber, making the wheel self-lubricating. The time required to replace the worn ring is trifling, and the weight of the complete wheel is about 2 lb. There appear to be no objections to the proposed construction, and we commend the idea to electric tramway managers as worthy of a trial.

**A Remarkable Arc Lamp.**—Some time ago we drew attention to the new arc lamp mechanism which Mr. Mensing had devised, which had only two working parts, and could be readily adapted to direct or alternate current working, open or enclosed. It appeared as though the acme of simplicity had been reached. Nevertheless, Mr. Mensing, whose patience and ingenuity seem to be inexhaustible, has gone one better—he has eliminated 50 per cent. of the working parts by reducing their number to *one!* Further, without sacrificing any other advantage, he has provided the lamp with a magazine capable of holding no fewer than 20 pairs of carbons, which will automatically replace one another as they are consumed. We would not ask our readers to believe these statements had we not personally seen the lamp burning, and the operation of automatically changing carbons carried out. The behaviour of the lamp was even better than that of the previous model, and we must congratulate Mr. Mensing on the remarkable results which he has attained.

**Electrical Trade with Italy.**—The last issue of the *Board of Trade Journal* says:—"There is room for the importation of electrical machinery, in spite of the many existing local shops and of the competition of Switzerland. Electrical traction is being developed considerably in all the Provinces of Italy, as well as electric light, the use of which is constantly increasing."

**Belgium.**—La Société de l'Accumulateur Tudor, of Brussels, reports a profit of £2,632 for the last financial year.

**Motor Contracts.**—We hear that the Electromotor and Dynamo Co., London and Manchester, has received orders for 175 H.P., 20 H.P., and several smaller motors for direct-driving, from Messrs. Pimm & Co., Wandsworth, a 50-KW. C.C. generator for the Acme Tone Engraving Co., two 20-H.P. C.C. motors, 90 r.p.m., and switchgear for J. and E. Hall, Ltd., Dartford, two 70-H.P. C.C. motors, and three 10-H.P. slow-speed motors and switchgear for the Crown Wharf Cold Storage Co., Southwark.

**Catalogues and Lists.**—Messrs. J. Christopher and Sons, of Clerkenwell, E.C., have issued lists relating to their new designs of cast-iron adjustable swivel bearings, convertible screw boss pulleys, and the Armitage non-slipping fibre cement pulley covering.

The Forward Engineering Co., Ltd., of 50, Cannon Street, E.C., have recently remodelled their improved "Otto" gas engine, and added improvements thereto. These alterations are detailed in a new illustrated price list which has lately been issued. Prices of high-speed crank-balanced engines for electric lighting from 4 B.H.P. to 40 B.H.P., also speeds, dimensions, weight and code words, are given. The Kynoch patent petrol starter is detailed.

Messrs. Mather & Platt, Ltd., have published the second edition of their steam engine catalogue, describing, with the aid of a number of excellent half-tone illustrations, their several types of engines and multipolar dynamos of large sizes, also their combined enclosed high-speed engines of small size for driving dynamos, pumps, &c. A number of tables show particulars, including weights and dimensions, of the firm's combined open-type vertical engines and multipolar dynamos; also combined high-speed engines and multipolar machines. Condensing plants of different kinds are described. The size and get-up of the list is characteristic of Mather & Platt's recent publications, and it makes an excellent companion to others that have gone before.

Messrs. Marryat & Place, of 28, Hatton Garden, E.C., have issued a new edition of their No. 6 list of "M.P." ironclad switches, fuses, circuit-breakers, and distribution boards. It has not been possible to reduce prices, but a number of new sizes have been added, these including their 10-ampere double-pole 500-volt switch. Both switches and fuses are listed in the larger sizes up to 400 amperes, and a complete range of distribution boards suitable for 500 volts has been added. Messrs. Marryat & Place are specialising this work now, chiefly for orders for standard articles. We understand that all the firm's standard patterns have been overhauled and minor improvements made during the last 18 months.

Messrs. Witting, Eborall & Co., Ltd., of Temple Bar House, E.C., have issued a new list (No. 105) describing, with illustrations, their standard controllers for direct current and three-phase motors, also resistances. A tabulated list of prices and dimensions is attached.

A new illustrated list (No. 213) of patent steam stop valves has been issued by Messrs. W. H. Bailey & Co., Ltd., of Salford.

Messrs. Ward & Goldstone, of Manchester, are about to issue a new catalogue containing their revised prices, and describing some improvements and novelties.

**Bankruptcy Proceedings.**—Under the failure of Chas. Manners Downie, described as an electrical engineer, carrying on business as the Lighting Corporation, at 4, Bloomsbury Square, and 15, Dyott Street, New Oxford Street, W.C., the first meeting of creditors was held on May 3rd, at the London Bankruptcy Court, before Mr. E. L. Hough, Senior Official Receiver. The receiving order was made on April 15th, upon the petition of Mr. H. B. Swift, electrical engineer, Upper Norwood. The debtor, who calls himself a commercial expert, states that he purchased as a going concern, from Mr. C. J. Singleton, receiver for the debenture holders, the stock and effects of the Lighting Corporation, Ltd. The price was originally £750, and completion was for March 20th, 1903, but from various causes completion could not be effected at that date, and the business at his (debtor's) wish, was continued by Mr. Singleton until last January, when the sale was effected. He then paid a further £806 for the new book debts, making, with the other amounts advanced by him in the interval for new stock, wages, &c., the full purchase price of £2,000. Of that amount £950 was his own money; £650 was found for the purpose by a gentleman and accepted by him (debtor) as premium for teaching him the business; and the balance of £400 was owing to him by the company for salary and commission. The debtor further states that he first commenced business in 1897. When in partnership with Mr. F. G. W. Adams, they supplied goods, electrical and general, as Downie & Adams, at 24, Newman Street. In September, 1899, Mr. Adams was made bankrupt and the business was immediately stopped. He (debtor) afterwards paid all the debts of that business that were demanded: there were doubtless some still owing, but he could not give a list of them, and did not know what became of the books of Downie & Adams. The partnership was by deed; each partner put in £1,000 cash on starting, and he subsequently provided further amounts. He estimated his loss in connection with that business at £5,000 cash and £25,000 in paper. From September, 1899, until October, 1900, he did nothing, but in the latter month he joined the Maxim Electrical Corporation, Ltd., as secretary and manager, at a salary of £400 per annum, and a bonus of £50 for every 10 per cent. dividend paid. He retained that post until about the middle of 1902, when he became connected with the Lighting Corporation as business adviser, with a minimum salary of £400 a year, a bonus of 1d. for every lamp sold, and 2½ per cent. of the profits. In addition to the £400 taken into account by Mr. Singleton on the sale to him of the business, he had not received more than £300 from the company. The debtor added that since January he had put into the business a further £100. It was wholly a credit trade; the accounts were rendered monthly, and there was work in hand to the extent of £170. He maintained that he had been brought to a standstill through being disappointed by persons who promised to provide, in return for a share of the business, funds which were to be used for working capital. The accounts filed by the debtor show:—Unsecured debts, £1,595 9s. 9d.; contingent liabilities, £50 Js. 4d.; and preferential claims, £181 0s. 5d. The assets are valued at £530 5s. 1d., and consist of:—Cash, £3 2s. 11d.; stock, £250 (cost £1,500); machinery, £50; fixtures and fittings, £50; good book debts, £175 3s. 1d.; and doubtful and bad debts together amounting to £258 7s. 1d., but only expected to realise £1 19s. 1d. The meeting was adjourned for a fortnight to enable the debtor to submit a proposal, the public examination being fixed for June 9th. A resolution was passed confirming the appointment of Mr. Singleton as special manager of the business.

A second and final dividend of 2s. 3d. in the £ is payable at Birmingham on May 14th, in *re* J. F. Worthington and G. Nuttall (J. Worthington & Co., electrical engineers, Hanley).

An order was made against D. T. Cameron, of Saltash, mechanical and electrical engineer, on May 5th. The first meeting and the public examination are to be held on May 20th and 31st respectively, the former at Plymouth and the latter at East Stonehouse.

The estates of Brown, Scott & Co., electrical and engineers' furnishers, of Glasgow, and R. F. Barr, jun., the sole partner of the firm, were sequestrated on May 4th.

**Dissolutions and Liquidations.**—The Blake-Morscher Electrical Ore Separator Syndicate is to be wound up voluntarily, with Mr. D. S. Whitelaw, 20, Copthall Avenue, E.C., as liquidator.

A meeting of the Tramways and General Appliances Co., Ltd., is to be held on June 7th at Birmingham, to hear an account of the winding up from Mr. H. C. Lewis, liquidator.

The Electrical "Lumiscriptor" Co. is to meet at 10, Walbrook, E.C., on June 15th to hear an account of the liquidation from Mr. R. Warner, the liquidator.

A meeting of the Coventry Lighting and Engineering Co. is to be held on June 8th, at Coventry, for a similar purpose (Mr. A. J. Cudworth, liquidator).

Notice is given in the *London Gazette* of the release of liquidators (Messrs. A. Whittaker and L. Broderick, Manchester) of the Steam Boilers Circulators Co., Ltd., Manchester.

Messrs. J. W. Cutler and W. Wardle (Cutler, Wardle & Co., electrical engineers, Manchester) have dissolved partnership. Mr. Wardle will attend to debts and continue the business.

Messrs. H. T. Harrison and P. J. Brewer (Haydn Harrison and Co., electrical engineers, 11, Victoria Street, S.W.) have dissolved partnership. Mr. Harrison will attend to debts.

Messrs. E. Morand and A. W. Curtis (Curtis & Morand, electrical engineers, Birmingham) have dissolved partnership.

**Book Notices.**—"Leçons sur l'Electricité." By E. Gerard. (Vol. I., Seventh Edition.) Paris: Gauthier-Villars. Fr. 12.

"Revue Economique Internationale," April, 1904. London: P. S. King & Son. 4s.

"The Country Gentlemen's Estate Book, 1904." Edited by Wm. Broomhall. London: The Country Gentlemen's Association, Ltd. 5s. 6d.

"A First Book of Electricity and Magnetism for the Use of Elementary Science and Engineering Students and General Readers." By W. P. Maycock. London: Whittaker & Co. Price 2s. 6d.

The *Index of the Technical Press*, which we have often noticed with approval, has now become the *Engineering Press Monthly Index Review*, and has greatly enlarged its sphere of operations. Separate editions are now issued each month in English, French and German, and a London office has been opened by the proprietors, the Technical Press Association, at 88, Chancery Lane, W.C. A leading article on steel alloys, and a number of extended abstracts of important technical articles, appear in the first number, in addition to the usual Index, which comprises references to nearly 1,200 articles. We cannot withhold our hearty commendation of this admirable publication, the only fault that we have noticed being a slight laxity in the spelling of English proper names.

"A Technological and Scientific Dictionary." By G. F. Goodchild and C. F. Tweeney. London: George Newnes, Ltd.

**The Prosecution of Hooley and Lawson.**—On Tuesday, Ernest Terah Hooley, the well-known company promoter, and John Henry Lawson, also well known in the financial world, appeared at Bow Street Police Court, on Tuesday, on a charge of conspiring to defraud Alfred J. Paine, of Westminster, in a variety of share transactions. Certain of the transactions were in respect of shares and debentures in the Electric Tramways Construction and Maintenance Co. In this connection we may refer our readers to a criticism of a prospectus in the Electrical Review for November 30th, 1900. The prosecution is being conducted in the public interest by the Public Prosecutor.

**The Spanish Tariff: Proposed Revision of the Duties.**—It is announced that the Spanish Government, as a result of applications made by native manufacturers, has appointed a commission to proceed with a scheme for revising the existing Customs tariff. It is assumed that the contemplated alterations will be in a protectionist direction, and the proposed conclusion of a treaty of commerce with Germany has been postponed by the Minister of Finance pending the completion of the inquiry which has just been instituted by the commission.

**New Fireproof Cable.**—Since we published a note by by Mr. E. K. Scott on fireproof cables, there has been quite an epidemic of such. The St. Helens Cable Co., Ltd., inform us that they are in a position to supply the electrical trade with a practical fireproof cable, for which the following properties are claimed:—(1) A flame, or even an arc, playing on a piece of this cable cannot set fire to it. (2) On withdrawing the flame, the cable is not only not alight, but not even glowing. (3) The fireproof properties of the cable are not affected by immersion in water, as the fireproofing materials are insoluble. It is hardly necessary to say anything as to the special uses of this cable, as switchboard and cable subway fires have been only too frequent of late years. Vulcanised rubber and Dialite insulated cables are also made up in this manner.

## Electrical Wares Exported.

WEEK ENDING MAY 12TH, 1903.

| | | |
|---|---|---|
| Accra. | Teleg. mat. | Value £70 |
| Alexandria. | Teleg. cable | 247 |
| Amsterdam | | 205 |
| Auckland | | 150 |
| Bangkok | | 26 |
| Bombay | | 386 |
| Buenos Ayres. | Teleph. mat. | 216 |
| Calcutta | | 543 |
| Cape Town | | 992 |
| ,, | Teleg. mat. | 1,476 |
| Colombo | | 17 |
| Copenhagen | | 99 |
| Demerara | | 120 |
| Durban | | 817 |
| ,, | | 2,829 |
| East London | | 204 |
| Gibraltar | | 138 |
| Hamburg. | Teleg. mat. | 250 |
| Hong Kong | | 18 |
| Lisbon. | Teleph. cable | 1,252 |
| Lyttleton | | 14 |
| Madras | | 188 |
| Malta | | 12 |
| Melbourne | | 565 |
| North Atlantic. | Teleg. cable | 6,000 |
| Oporto. | Teleph. cable | 50 |
| Perth | | 411 |
| Port Elizabeth | | 118 |
| ,, | Teleg. mat. | 345 |
| Port Said | | 52 |
| Shanghai | | 815 |
| Sierra Leone | | 20 |
| Singapore | | 12 |
| ,, | Teleg. mat. | 101 |
| Sydney | | 849 |
| Wellington. | Teleg. mat. | 1,091 |
| Yokohama | | 637 |
| Total | | £21,325 |

WEEK ENDING MAY 10TH, 1904.

| | | |
|---|---|---|
| Aden | | Value £46 |
| Alexandria | | 43 |
| Amsterdam | | 131 |
| Antwerp. | Elec. fuses | 800 |
| Ascension. | Teleg. mat. | 1,178 |
| Auckland | | 110 |
| Calcutta | | 1,357 |
| ,, | Teleg. mat. | 61 |
| Cape Town | | 188 |
| Channel Islands | | 71 |
| Colombo | | 487 |
| ,, | Teleg. mat. | 17 |
| Delagoa Bay | | 592 |
| Durban | | 6,482 |
| East London | | 325 |
| Fremantle. | Elec. machinery | 191 |
| Gibraltar | | 117 |
| Hamburg | | 12 |
| ,, | Teleg. mat. | 200 |
| Hobart | | 16 |
| Hong Kong | | 687 |
| Karachi. | Elec. machinery | 106 |
| Lisbon | | 125 |
| ,, | Telephones | 62 |
| Lyttleton | | 118 |
| Melbourne | | 455 |
| Nagasaki | | 295 |
| Oporto. | Teleph. mat. | 30 |
| Paris | | 95 |
| Penang | | 400 |
| Port Elizabeth | | 38 |
| Reval | | 123 |
| Rio Janeiro | | 12 |
| ,, | Teleg. mat. | 5,374 |
| Rotterdam | | 15 |
| Shanghai | | 78 |
| Singapore | | 4,060 |
| Spezia. | Teleg. mat. | 18 |
| Stockholm | | 16 |
| ,, | Teleg. wire | 85 |
| Sydney | | 1,555 |
| ,, | Teleph. cable | 849 |
| Wellington | | 95 |
| Yokohama | | 1,477 |
| Total | | £28,102 |

## Foreign Goods Transhipped.

| | | |
|---|---|---|
| Cape Town. | Telph. mat. | Value £2,367 |
| Oporto. | Teleph. mat. | 50 |
| Total | | £2,377 |

**An Exhibition at Newcastle.**—On October 1st there will be opened at Newcastle-on-Tyne a Trades, Arts and Industries Exhibition, which is being arranged by Newcastle Exhibitions, Ltd., with Mr. W. A. Cowie, 43, Grainger Street, as managing director. The exhibition will remain open for six weeks (until November 12th), and a prospectus can be obtained on application to Mr. Cowie.

**Trade Announcements.**—Mr. Herbert W. Umney, M.I.M.E., has been appointed as London and district agent (46, King William Street, E.C.) for Messrs. Rubery & Co., of Victoria Iron Works, Darlaston, for their constructional steel work, motor-car and wagon frames, &c. Mr. Umney has also been appointed agent for the London district for Messrs. W. T. Bowie & Co., of Barrowfield Wire Rope Works, Glasgow.

Mr. Ernest Syer has removed from 23, Cross Street, Hatton Garden, to 45, Hatton Garden, E.C.

In order to cope with increased business, the Corlett Electrical Engineering Co., Ltd., have acquired larger premises situated in Wilcock Street, Wallgate, Wigan. All communications should be sent to that address in future. In addition to the equipment of the works with suitable plant for manufacturing their various specialities, the company have provided ample facilities for repairing all kinds of electrical machinery.

Mr. Herbert Arnold has taken over the business of A. G. Arnold and Co., 4, Market Street, Newport, Mon., and will carry it on under the title of A. G. Arnold & Son, at the same address.

In the course of his speech to the shareholders of the Morris Aiming Tube and Ammunition Co., Ltd., held at 17, Charing Cross Road, W.C., last week, Capt. J. W. Reid, the chairman, said:—"The board consider that the time has now come when we can profitably and advantageously extend the scope of our business. Our power plant at Dagenham runs most economically when at full pressure, and having some power to spare, we have decided to use it in developing a branch of business with which we have always had to do, and with which we are fully competent, both in knowledge and connection, to deal. We are erecting another shop and the necessary plant and machinery for the manufacture of dynamos and electric motors—not motor-cars, understand me, but motors—for which there is a large and ever-increasing demand. We have every confidence in the success of this new branch of our work, and can interweave it most satisfactorily with our present business."

Messrs. Veritys, Ltd., have opened a branch at 33, Highbridge, Newcastle-on-Tyne, where stocks of main switches, accessories, motor starters, wire, Simplex conduit, &c., are held. There is also at the same address a well-equipped showroom containing a display of electric light fittings. Mr. J. L. Miller, who has been Messrs. Veritys' representative in the district for the past four years, is manager of the new branch.

**Electrical Plant for the Wolsingham Steel Works.**—Messrs. John Rogerson & Co., proprietors of Stannersclose Steel Works, Wolsingham, Durham, have just placed with Messrs. Bruce Peebles & Co., Ltd., engineers, Newcastle-on-Tyne, a contract for the complete electrification of their works. The plant will consist of three Lancashire boilers, two 150-KW. high speed engines with generators, 13 motors, 60 arc lamps, and the usual cables and small lighting. These steel works are understood to be about the oldest in Great Britain, and an interesting point about the plant is that the steel castings and steel shafts will be manufactured at Messrs. Rogerson's own works.

## LIGHTING AND POWER NOTES.

**Aston.**—The T.C. has received from the L.G.B. sanction to raise loans of £50,000 for E.L. purposes.

The following scale of charges for energy has been adopted:—Power, 1½d. per unit for 22 hours per day, and 3d. for the other two hours, or an alternative flat rate of 1½d. per unit; consumers whose load factor is less than 10 per cent., to be charged at the usual lighting rates; lighting, a flat rate of 2½d. per unit for the six months ending March 31st, 1904.

The supply of fittings on the free-wiring system has been discontinued.

**Belgium.**—A new electricity works is to be erected at Ghent; tenders for the erection of the buildings have just been invited.

**Birkenhead.**—The electric lighting accounts for the year show the income from the sale of electricity to have been £10,720 4s. 4d., as compared with £9,065 10s. 11d. in the preceding year. The total income was £11,418 18s. 5d., against £9,624 6s. 2d. After meeting works expenditure, a balance of £6,784 12s. 1d. remained, as against £5,862 10s. 5d. last year. After paying interest and other charges, a balance of £1,386 0s. 4d. remained for transference to renewals account. This account, with £996 0s. 10d. brought forward, now stands at £2,382 1s. 2d.

**Bombay.**—The *Times of India* for April 16th contains a copy of an application which is being made by the Brush Electrical Engineering Co., of London, under the Indian Electricity Act, 1903, for power to supply electricity within the "city, town, and island of Bombay."

**Brighton.**—A L.G.B. inquiry into the application of the Corporation to borrow £10,000 for electrical purposes, was held on 5th inst. £4,000 of this amount is required to pay the cost of changing over the standard pressure of supply similar to that carried out in other parts of the borough, and for which a loan had already been sanctioned. The period asked for repayment of the £4,000 was 25 years. The balance, £6,000, is for the purchase of motors for hiring out purposes, and the period for repayment of this amount, 15 years. The change-over has been rendered necessary by re-arrangement of the switchboards in connection with the new works at Southwick, and it is necessary that this be done immediately. Opposition was offered by several ratepayers' deputations, and in reply to one of these, the town clerk stated that £13,961 had, during the 13 years' working of the undertaking, been applied to the relief of the rates out of the profits. It was also stated that the Corporation had bought motors to the value of £3,443, this amount being included in the £6,000 asked for. The amount received in rental from the hire of these motors, 132 in number, was £528, and the consumption of energy for power purposes had increased by many hundred thousand units.

**British East Africa.**—A concession has been obtained from His Majesty's Commissioner for the East Africa Protectorate by Mr. Clement Hirtzel, electrical engineer, for the sole and exclusive right to supply electrical energy for the purposes of power and lighting to the town and 15-mile radius of Nairobi. The period for which this concession extends is stated in the preliminary prospectus to be 10 years, and in the event of its proving satisfactory during that time it will be renewed on the same terms for another period of 15 years. There are at present in the town and district through which the line will pass 3,000 lights required, which at an average charge of Rs. 1·4 per lamp per month, would amount to Rs. 3,750 per month. The working capital of the syndicate is Rs. 300,000 in Rs. 15 shares. Mr. Hirtzel is coming to England shortly to arrange matters to float a company for the carrying out of this concession. He will be supported, it is added in the prospectus, by "one of the largest electrical firms in Great Britain."

**Burton-on-Trent.**—Mr. P. J. Pringle, the borough electrical engineer, has just issued his annual report on the working of the electricity undertaking for the year ending March 31st last, this being the tenth year. Below we give the details in brief:—

| | 1903-4. | 1902-3. |
|---|---|---|
| Capital expended to date | £66,200 | — |
| Total revenue | 8,962 | £5,561 |
| Total costs | 4,312 | — |
| Gross profit | 4,650 | — |
| Financial result after providing for interest and sinking fund | +1,197 | +163 |
| Number of units sold | 678,020 | 268,992 |
| Total cost per unit | 1·52d. | 2·53d. |
| Average price obtained per unit for all kind of supply (including traction for eight months) | 3·1d. | — |
| Maximum load | 370 KW. | — |
| Capacity of plant (at end of year) | 1,110 KW. | 810 |

Consumers increased by 21·1 per cent.; lighting and power, 21·7 per cent.; motors connected, 79 per cent.; total increase in units, including traction, 162 per cent.

**Bury.**—The output of electricity at the Corporation works for the year ending March 31st was 672,911 units, and the revenue £8,010, compared with an output of 424,993 units and a revenue of £6,170 in the previous year, an increase of 58 per cent. in the units consumed and of 30 per cent. in the revenue.

**Cannock.**—The U.D.C. has decided to apply for sanction to borrow £8,000 for the purposes of electric lighting, which is to be carried out under a special agreement with a Dudley firm.

**Cape Town, S.A.**—On the 14th ult. the formal opening ceremony of the new central electric power station took place. There was a large assembly of spectators, and the new works were opened by Mr. D. P. de Villiers Graaff, ex-mayor of Cape Town, who was largely concerned in the establishment of the Corporation's first electricity works. Mr. W. F. Long, the City electrical engineer, made a statement regarding the works, and said that in February last there were 78,850 8-c.p. lamps connected, and motors of no less than 1,375 B.H.P. Electricity is charged for on a sliding scale ranging from 1s. 2d. to 8d. per unit; a double tariff is in force, daytime consumers being charged only 8d. to 4d. per unit. The mayor, Mr. Councillor W. Thorne, then switched on the supply, and stated that the capital expenditure had amounted to over a quarter of a million sterling. Mr. J. Cook, City Engineer, designed the buildings. Messrs. Davis and Soper, of St. Mary Axe, are the London agents to the Corporation, and Mr. H. D. Wilkinson is the inspecting engineer to the Corporation at this end.

**Colchester.**—The T.C. has fixed the following charges for electric light:—5d. per unit for the first 2,000, and 4½d. per unit to consumers of from 2,000 to 5,000 units.

**Crediton.**—Messrs. Christie Bros. & Middleton, electrical engineers to the Council, have written stating that there is no prospect of the E.L. scheme being carried out, because the underground cable system adopted by the Council would necessitate additional capital. The Council has now decided in favour of overhead wires being used, and a special meeting will be held to give the necessary permission.

**Croydon.**—The T.C. has decided to include in its next Parliamentary Bill provisions for further powers in connection with electricity supply, wiring, fittings, motors, &c., and power to supply energy in bulk or otherwise outside the town.

**Darlington.**—The question of adopting a municipal free-wiring system for dwelling houses has been abandoned for the present by the Electrical Committee. The T.C. has appointed a Committee to consider the question of free-wiring through a private company and the advisability of adopting a motor hire-purchase scheme.

**Darwen.**—It has been announced that the loss on the electricity department for the past year was £38. The profit last year was £104.

**Dudley.**—At the meeting of the Town Council last week it was stated that, in connection with the Corporation electrical undertaking, there had been an increase in the supply of 470,000 units. The gross receipts for the year had been approximately £10,600, while the working expenses had amounted to £5,608, showing a gross profit of £4,924.

**Durham.**—The County Council has written to the B. of T. stating that as the Board had decided to grant a prov. order to a company in the east of Durham for electric lighting over a large area, for a term of 43 years, against the express wish of the local authorities, the Council would protest against the confirmation of the order, and would represent to Parliament that the C.C. has under consideration the development of an electric supply scheme for the county, which such orders as those under notice would seriously retard.

**Exmouth.**—The U.D.C. has resolved to apply to the B. of T. for an extension of time for its prov. order for electric lighting, which, it is stated, will lapse on the 25th inst. Messrs. Crompton & Co., who have taken over the order, have informed the Council that, owing to the state of the money market, they cannot obtain capital to carry out the work at present. The agreement with the contractors was dated March 16th, 1903, and they undertook to secure a site within 12 months, and to completely equip the station within two years.

**Gateshead.**—At a meeting of the T.C. on the 4th inst. a large deputation waited on the Council to urge that the offer of the County of Durham Electric Power Distribution Co., Ltd., to reduce the price of lighting on consideration that its tenure be extended from 13 to 19 years be accepted. The Mayor said that the matter had been considered and re-considered, and they had resolved not to extend the time to the Electric Power Co. for more than one year. The 14 years of the Tramways Co. dated from 1901, and the periods were 7, 14, and 21 years. The Electric Light Co.'s arrangement dated from 1899, and it was for 13 years, and two years' notice at the end of that time for terminating that agreement. The Council thought it would be wrong to prevent the arrangements with the Tramways Co. and the Lighting Co. being co-terminous. In thus acting he believed the Council was doing the best for the town.

**Germany.**—The Bliesenbach Bergwerks Gesellschaft, of Düsseldorf, has decided to put down a plant for lighting and power purposes in connection with its works.

**Hamilton (Australia).**—A company is being formed to install electric light in Hamilton, the nominal capital is stated to be £3,000. No opposition from the ratepayers is anticipated, and the company hopes to have the plant installed in the course of a few months.

**Hampton Wick.**—The B. of T. has granted a prov. order to the Twickenham and Teddington Electric Supply Co., Ltd., for the supply of energy in Hampton Wick, Esher, the Dittons, East and West Molesey, Sunbury, Hanworth, Feltham, Ashford, and Shepperton.

**Horley.**—The B. of T. has granted a prov. order for E.L. to Mr. Marshall H. Bennett, for the parish.

**Hornsey.**—In our issue of April 29th we stated that a reduction in the prices for electrical energy had been made by the U.D.C. This we find is not correct.

**Hull.**—The minutes of the E.L. Committee of the City Council recently contained a recommendation to supply the North-Eastern Railway Co. with electricity in bulk at 1½d. per unit for a 27 per cent. load factor with an increase or a decrease of $\frac{1}{10}$d. per unit for each 3 per cent. increase or decrease in load factor. The proposed agreement was conditional upon the company taking not less than 1,000,000 units per annum for a period of not less than three years. After discussion, the matter was referred back, it being contended that it would not be profitable to supply at that rate.

**Ilford.**—The L.G.B. has informed the U.D.C. that the Council is not empowered to purchase motors for letting out on hire, and consequently no loan will be sanctioned for that purpose.

**Kettering.**—This town was *en fête* on Saturday last, Mr. Andrew Carnegie, "modest Andrew" as he is dubbed by a daily contemporary, going down to open the free library which he has presented to the inhabitants; the electricity works and dust destructor were formally inaugurated the same afternoon, and the festive proceedings terminated with a banquet at the Royal Hotel in honour of Andrew Carnegie, Esq., LL.D. Judging from this gentleman's speech to the toast of his health, we can well believe that he was fully alive to the quotation which was connected with his name, "None but himself can be his parallel," and that nobody is more able to appreciate at its full value the worldly advantage of true belief in the national prayer of Scotland, "O Lord, gie us a guid conceit o' oorsels." But it is with the electricity works that we are concerned.

The station, which was well filled with visitors, was formally opened by Mr. Saunders, ex-chairman of the Lighting Committee of the Council; Dr. Kennedy, F.R.S., who, with his partner, Mr. Jenkin, is joint engineer to the undertaking, illustrated to his audience by the simple device of a skipping rope the action of a dynamo (Dr. Kennedy did not actually perform, although we have reason to believe he was quite ready to skip at the first opportunity that presented itself); and Mr. Meldrum won our admiration by his insistence upon the ability of his destructor to develop high-pressure steam, and therefore high-pressure and high quality electricity. Mr. T. J. Bakewell is the electrical engineer. We hope to give a complete description of the works in a future issue; in the meantime we may mention that the contractors were as follows:—

For the building, Messrs. Heycock & Sons, of Great Glen, Leicester; boilers, Messrs. Danks, of Oldbury, Birmingham; engines, Messrs. Willans & Robinson, Rugby; pipe work, Messrs. Babcock & Wilcox, London; arc lamps, the Gilbert Arc Lamp Co., Chelmsford; cables, mains, and arc posts, Messrs. W. T. Glover & Co., Manchester; switchboard, Messrs. Cox-Walkers, Darlington; economiser, Messrs. E. Green & Sons, Wakefield; service meters, Messrs. Chamberlain and Hookham, Birmingham; batteries, the Electrical Power Storage Co., London; wiring of the station, Messrs. Lea & Warren, Kettering; refuse destructor, Messrs. Meldrum Bros., Manchester; dynamos, Messrs. T. Parker, Ltd., Wolverhampton; glazing work, Messrs. Helliwell, Manchester; feed pumps, Messrs. G. & J. Weir, Glasgow.

**London.**—Messrs. Ernest Probert & Co. have recently completed the electric lighting of Bow County Court, and the remodelling of Messrs. John Barker's installation of 3,000 lights.

Stepney.—The abstract of accounts and balance-sheet of the electricity undertaking of the B.C. for the year ending March 31st last, shows that during the 12 months £45,838 was spent on capital account, making a total expenditure under that head of £199,129. The revenue account shows an expenditure of £13,823 as against £10,125 in the previous year. Amongst the chief items are:—Coal, £3,779 (£2,710 during 12 months ending March, 1903); steam from dust destructor, £2,945 (£2,034); wages at generating station, £1,485 (£1,162); attending and repairs to public lamps, £1,449 (£1,107); accountants and staff, including storekeepers, salaries, £1,080 (£919); rates and taxes, £537 (£291); engineers' department salaries, £427 (£369). The gross receipts were £26,616, as against £19,625 in the previous year. 2,533,511 units were sold (1,759,349 units were sold in the preceding 12 months). The credit balance of £12,814 on revenue account is reduced to £5,936 by payments of interest and sinking fund, and it is intended out of this to write off £1,038 from capital account; £2,833 was so written off last year. The Committee has the revision of the tariff under consideration. The total cost of each unit sold was 1·82d. The average price obtained per unit was 2·66d. for private lighting, 1·61d. for public lighting, and 2·36d. for power.

Hackney.—A sum of £8,910 has been passed by the Finance Committee of the B.C. for mains extensions.

St. Pancras.—On 4th inst., at the meeting of the B.C., the special committee appointed to consider matters regarding the recent action of Colwell and others for damages for vibration reported that the plaintiffs required £8,906 12. 9d., which includes the properties and the whole of the trade interests, to settle their claims. It was decided to pay the amount and charge the same against the electricity reserve fund. A motion was passed to put penny-in-the-slot electric meters in the new municipal workmen's dwellings, the meters to be set to charge at the rate of 4d. per unit.

**Luton.**—The T.C. has decided to extend its mains at an estimated cost of £850, to supply energy for power purposes to manufacturers.

**Macclesfield.**—The Cheshire C.C. has instructed Messrs. Lacey, Sillar & Leigh to prepare the necessary specifications for the electrical plant, wiring, &c., for the Parkside Asylum.

**Manchester.**—On May 5th a L.G.B. inquiry was held into the application of the Corporation for loans of £94,490 for additional mains, £10,000 for the development of the motor-hiring scheme, and £21,575 for lighting and traction purposes. There was some opposition on behalf of property owners who objected to the rates being further increased.

**Mynyddislwyn.**—The T.C. has instructed its clerk to obtain particulars of any water power in the district that could be utilised for electricity generating purposes.

**Newport (Mon.).**—The Electricity Committee proposes to carry additional cables over Newport Bridge slung through the cantilevers carrying the footpath. The borough engineer's department, however, recommends that the cables be laid across the bed of the river.

**Oulton Broad.**—The business of Messrs. Barber, Croft and Co., who supply energy for private lighting and power purposes, is being taken over by a locally-formed company, which is applying to the B. of T. for a prov. order. The U.D.C. is also applying for an order, but the company, we are informed, is endeavouring to come to terms with the Council.

**Portsmouth.**—The E.L. Committee of the T.C. has entered into an agreement with the Admiralty for the supply of electricity at the Royal Naval Gunwharf, the agreement being for four years, and thereafter until the expiration of six months' notice. It has been decided to apply to the L.G.B. for sanction to borrow £5,000, the estimated cost of alterations and additions recommended by Mr. Manville, at the electric light station.

**Queenborough.**—An electric generating station has been erected on the shore for working the cranes and capstans on the new railway pier, which was opened by the chairman of the S.E. and C.R. recently.

**Rotherham.**—The annual report of the Corporation E.L. undertaking states that a net profit of £1,278 has been made. The gross profit was £6,068.

**Spain.**—Application has been made for a concession for lighting the town of Betera by electricity.

**Stalybridge.**—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has reduced the price of energy for lighting from 4½d. to 4d. per unit, and for power a sliding scale from 2½d. to 1d. per unit has been adopted, with special terms to large consumers.

**Stroud.**—The Gloucestershire Electric Power Co. has been granted a prov. order by the B. of T. to supply energy to the rural district of Stroud, the urban district of Nailsworth, and the parish of Dursley.

**Trowbridge.**—A prov. order for E.L. has been granted by the B. of T. to the Western Electric Distributing Corporation, the area of supply including Trowbridge and Bradford-on-Avon (Urban and Rural).

**Tunbridge Wells.**—The Lighting Committee of the T.C. has decided to recommend the Corporation to decline the offer of a syndicate to purchase its electric light undertaking for £80,000, allowing a profit of £10,000 on the capital expended.

**Walsall.**—The Corporation's Town Hall Committee has recommended the Council to expend a sum of £782 for extras at the new Town Hall in order to provide electric lifts, &c. The Electricity Committee proposes to lay a main as far as the workhouse on the Pleck Road, at a cost of £413.

**West Ham.** — Messrs. Tate & Co., Silvertown, have approached the B.C. relative to a supply of energy for motive power, estimated at not less than 500,000 units per annum, and ultimately, over 1,500,000 units. The firm, however, object to paying 1d. a unit, and the Council, with a view to meeting them and other manufacturers in the matter of price, has circularised the latter in North Woolwich, asking if they would be prepared to take a D.C. supply at 500 volts, and enter into an agreement to consume a minimum amount for three years.

**Weybridge.**—The B. of T. has informed the U.D.C. that it has decided to grant the Walton-on-Thames electric light order.

**Willesden.**—The U.D.C. is considering the insertion of a proviso in the Harrow Road and Paddington Tramways Bill to preserve the rights of the Council conferred by the Metropolitan Electric Supply Co.'s Acts of 1898 and 1901. The electrical engineer reported against the adoption of a flat rate in lieu of the maximum demand system. Last quarter 92·37 per cent. of the consumers paid 6d. and under for their supply, and 82·90 paid 5d. and under. In the same three months only 5·76 per cent. of the consumers paid 7d. and over.

**Wimbledon.**—The Electricity Department of the U.D.C. will hold an electrical exhibition at the Worple Hall, from the 16th to the 28th inst.

**Worthing.**—The T.C. has adopted the recommendation of the Special Committee appointed to consider the cost of public lighting, *i.e.*, that the cost in future shall be based on the actual cost price per unit generated, including management, distributing and capital charges. Meters are to be fixed to each arc lamp circuit. The Corporation has been paying considerably less for energy for public lighting than it cost to generate.

## TRAMWAY AND RAILWAY NOTES.

**Australian Commonwealth.**—The State Governments of Victoria and South Australia have recently considered the question of the electrification of their suburban railways, respectively around Melbourne and Adelaide. Preliminary reports from the Railway Departments have indicated that there is reasonable prospect of the conversion of the lines proving a financial success, particularly in the case of Melbourne, where there is an extensive network of local lines carrying a frequent service throughout the day. It is now reported that negotiations are in progress between the Premiers of the two States with a view to the joint engagement of an engineer of standing, who should visit the colonies, and report upon the matter in all its bearings. At the same time, the electrification of the tramways of Adelaide (*vide* Electrical Review, p. 623 *ante*) would be thoroughly considered, as undoubtedly this will be taken in hand in priority to the railways of that city.

**Birkenhead.**—The accounts of the Birkenhead tramways for the year ending March 31st, 1904, have been issued. The total income from the tramways for the year was £55,945 18s. 7d. against £52,559 4s. 9d. in the previous year. The management and traffic expenses were £24,382 5s. 3d.; electrical expenditure, £7,844 2s. 8d.; surveyor's expenses, £2,521 0s. 11d., leaving the sum of £21,198 0s. 7d. to be carried to revenue account.

**Blackburn.**—At the T.C. meeting last week it was reported that the estimated loss on the tramway undertaking, for the year ended March 31st, was £4,900, against £4,075 in the previous year. The increase is accounted for partly by bad trade and bad weather, and also by the Audley extension, which has not proved remunerative.

**Bolton.**—The results of the working of the Corporation tramways are causing some disappointment. The balance-sheet of the department, for the year ending March 31st, showed an expenditure of £92,835, as compared with £80,737 in the preceding 12 months; and the income (consisting of traffic receipts) £93,395, against £85,703. The profit earned was £2,260, against £4,966 in the previous year. It is pointed out, as some consolation, that during 1903 important concessions were made to the travelling public; and if they do not get a return, in the shape of profit, the ratepayers benefit by the increased convenience and cheaper fares. Some members of the Council think that the Tramways Committee has gone a little too far in the latter direction, and a reduction in the number of cars employed is suggested.

**Bootle.**—At last week's T.C. meeting the following notice of motion was considered in committee:—

That this Council is of opinion that it will not be to the interests of the borough to grant Liverpool the privilege of running trams down Balliol Road, and that the resolution of the Council on April 20th last be rescinded accordingly.

**Bournemouth.**—At a meeting of the T.C. held on May 2nd, the following figures for the year ended March 31st, 1904, were presented by the borough accountant in the report of the Tramway Committee:—Total receipts, £53,398 14s., working expenses, £29,277 18s., leaving a balance of £24,121. From this had to be deducted £16,386 14s. for dividend on stock, bank interests, and contribution to stock redemption fund, leaving a net balance for the year of £7,734. The total net credit balance from the commencement of running on June 23rd, 1902, was shown to be £12,684 16s. This, however, is subject to a possible deduction of £2,462 17s. 3d., being the proportion of a full half-year's dividend on stock given away on the new issue in July, 1903, paid out of revenue, in respect of which application has been made to the Local Government Board that it may be treated as part costs of the issue of stock, and thus be regarded as a capital charge. The traffic manager (Mr. C. Barber) reported that the working expenses for the year were equivalent to 6·88d. per car-mile, and the receipts to 12·54d. per car-mile. The working expenses for the full financial year were equivalent to 54·82 per cent. of the receipts, which, compared with other systems, was a very good figure. The total number of passengers carried had been 9,363,985, the average receipts per passenger being 1·34d. The total number of car-miles run had been 1,022,163·75. There had been a comparative freedom from accidents of a serious nature, the total number having been 252, the majority of which had been but trifling.

**Burton-upon-Trent.**—Mr. P. J. Pringle, the borough tramways manager, in his report for the year ended March, 1904, said that the revenue from traffic for the year was £11,574, and the operating costs £8,919, After deducting financial charges, there was a surplus of £718. The passengers carried were 2,566,134, and the car-miles run 282,378; the population was carried 75 times over. The traffic revenue was 9·84d. per car-mile, and per passenger 1·084d. The costs per passenger were ·83d. The units used per car-mile were 1·285. The total revenue per car-mile was 10·14d. The energy was purchased at 1·45d. per unit, and the total operating costs were 7·57d. per car-mile.

**Clydebank.**—Messrs. A. Stark & Son, Glasgow, have received the contract from the Glasgow T.C. for constructing the extension of the tramway system in Clydebank.

**Essendon and Flemington (Victoria).**—Early last year Mr. A. E. Morgans laid a proposal before the Councils of Essendon and Flemington, two of the outlying suburbs of Melbourne, for the construction of a system of electric tramways to serve the two districts, and in particular, the racecourse at the latter. Subject to certain rights of purchase, the approval of the Municipalities was obtained, but the sanction of the State Government was also necessary, and this was withheld on the ground that the trams would injuriously affect the traffic upon the State-owned railways. However, as the result of much negotiation, the Government have been induced to reverse their former decision and to allow the scheme to proceed.

**Falkirk.**—The Edinburgh syndicate who have taken over the provisional order to promote the Falkirk electric tramways have written to the Town Council, agreeing to pay the two years' rent which is due in July. The Council's Special Tramway Committee having agreed to recommend the Council to allow the company the privilege of Sunday running of the cars, it is anticipated that there is every likelihood of immediate action being taken to secur e the first practical steps of the undertaking.

**Glasgow.**—It is expected that this week the Corporation Tramways Committee will have a meeting with representatives from Paisley T.C. in connection with the deadlock that has ensued between Mr. Murphy and Glasgow as to the terms on which the latter will have powers to run their cars right through to Paisley Cross.

A foreman linesman in the tramways department of the T.C. has designed a mechanical trolley ear, which has been tried by the department and found to work satisfactorily. The question of protecting the invention, and securing the sole rights of it for the Corporation and the inventor, has been remitted to a Sub-Committee of the Tramways.

**Leicester.**—On Wednesday next the formal opening of the new electric tramways will take place. Mr. Councillor Flint, chairman of the Tramways Committee, will open the power station, while the Mayor and Alderman Smith will start the first electric cars. Light refreshments and speeches will conclude the programme.

**Newcastle-on-Tyne.**—At the meeting of the City Council on the 4th inst., a report was presented from the Parliamentary and Bye-laws Committee and the Tramways Committee relative to the Tyneside Tramways and Tramroads Bill. The report embodied the correspondence between the solicitors to the company and the town clerk, and the joint Committees recommended that they be authorised to consider any proposals by the company which might promote a settlement of the points at issue with regard to running powers, and therefore avoid further litigation. Sir Charles F. Hamond, in submitting the report, asked to be allowed to make an addition to it—a stipulation that the Tyneside Co. should take no further steps to forward their Bill until the decision of the conference was known; also to add the following words:—"That this Council authorise the Committees to ascertain from the Tyneside Tramways Co. on what terms they would be disposed to sell the entire undertaking in their trams; and, if not, whether they would be willing to lease the same, the Corporation to have entire control of the working of the lines and the keeping of them and their equipment in repair." After considerable debate, Sir Charles Hamond agreed to hold over the suggestion as to purchase, and the report, with the addition of the first suggestion of Sir Charles, was adopted. In the course of the debate, Mr. Cail, the late chairman of the Tramways Committee, who recently resigned, made a lengthy statement as to his reasons for so doing. He said that, towards the end of August, 1902, Dr. Spence Watson, on behalf of the Tyneside Tramways and Tramroads, asked him to bring the question of an exchange of traffic between that company and the Newcastle-on-Tyne Corporation before the Tramways Committee, which he did at the next meeting, and the suggestion seemed to meet with general approval, and a Sub-Committee was appointed. He studied the question, and came to the following conclusions:—

1. That, if the convenience of 100,000 monthly, or nearly 1½ millions yearly, of the public—many of them their own ratepayers—who used their cars to and from Wallsend, could be furthered without inconvenience to the larger public inside Newcastle, then it was their duty to do so.
2. He realised that when the North-Eastern Railway substituted fast electrica trains every 10 minutes in place of the present comparatively slow steam trains, then the only way to retain a fair and payable proportion of the Wallsend traffic would be to get to the centre of Wallsend instead of stopping half a mile away, as they did now.
3. The very great inconvenience, not only to the workmen, but to the Newcastle system, which now arose through having to deposit them half a mile from their work, and having to keep cars blocking the main line at night to pick them up would be entirely avoided if they would carry them to the yard gates and pick them up on a branch line, viz., that joining the Newcastle high and low lines.
4. He also believed that the Council originally intended to cater for the public travelling to and from Wallsend, or why did they construct the three-quarters of a mile beyond Walker Gate, running, as it did, between green fields, where there was not any pick-up traffic?
5. He certainly believed he had the Committee at his back who had unanimously appointed the Sub-Committee to meet the Tyneside Co. The meeting was held on August 25th.

Continuing, Mr. Cail said he was asked to submit a report on the matter, and did so, in the form of a letter to the members of the Committee, in which he outlined the terms upon which the exchange of traffic would be made. On October 9th a meeting was held specially to consider the question, but at that meeting the proposed terms were absolutely never discussed, but a motion was at once carried that the negotiations be broken off. When the Tyneside Co. presented their present Bill to Parliament, he suggested that a special committee should prepare evidence to be given by the Corporation against the compulsory powers sought. This was done, and he was asked to put any evidence he could or would give in writing. This he did, and that was the evidence he gave before the Lords Committee, except that in evidence he expressed the view that if the travellers to and from Wallsend had to have through cars, then this should be brought about by the Newcastle cars running the extra half mile to the centre of Wallsend instead of the Tyneside cars running 3½ miles to the centre of Newcastle. He emphatically repudiated the insinuation that he had sold the Committee, and in face of that insinuation he felt that he had no course open but to resign.—Mr. J. J. Gillespie, the late vice-chairman, said he also resigned because he was, and had been, in accord with Mr. Cail.—There was no discussion upon the statement, but later it was referred to as a "fair and honourable statement."

**L. & N.W. Railway.**—It is reported that the company is completing preliminary arrangements for the electrification of its Newport-Pagnell branch line in Buckinghamshire.

**Mansfield.**—The B. of T. has granted a year's extension to the Mansfield and District Light Railway Co. for the completion of the electric tramways. The plans have been approved of, the deposit of £4,000 paid, and the material is ready for the commencement of the work. The company is negotiating with Mansfield U.D.C. for the supply of energy.

**Newport (Mon.).**—The T.C. has applied to the B. of T. for a loan of £45,250 for tramway purposes.

**Rotterdam.**—The Rotterdam Tramway Maatschappij, which has in operation a total milage of 19 miles, and also comprises the lines to Schiedam and Overschie, is now being converted into a Belgian company, with headquarters at Brussels and a share capital of £360,000, as compared with loan and share capital amounting to £251,000 in the case of the old company. It is proposed to transform the lines to electric traction. The new company has a concession for 21 years, and powers to construct a further length of 7 miles of tramway.

**Scarborough.**—On Friday last the electric tramway system was inaugurated, the ceremony being performed by the Mayoress. The guests, 120 in number, afterwards sat down to luncheon at the Balmoral Hotel, Mr. W. S. Rowntree (chairman of the Scarborough Electric Tramways Co.), presiding. The construction of the system was carried out by Messrs. Edmundson's Electricity Corporation. The usual loyal toasts were followed by the toast of "The Corporation," proposed by Mr. A. A. C. Swinton, one of the consulting engineers, and responded to by the Mayor. Councillor Rowntree proposed "Success to the Scarborough Electric Tramways," and the chairman responded. The "Consulting and Contracting Engineers," was proposed by Councillor Whittaker, and responded to by Mr. J. E. Waller, who was consulting engineer for the permanent-way work, and Mr. F. E. Gripper (speaking on behalf of Edmundson's Electricity Corporation). The tramway company takes its supply from the station of the Scarborough Electric Supply Co., Ltd., where additional turbo-generating plant (continuous current) has been installed for the purpose.

**South Staffordshire.**—Notwithstanding the fact that the Board of Trade have given the South Staffordshire Tramway Co. permission to use steam on their route for a further term of six months, a deputation from the Wednesbury Town Council wanted to interview the Board in the hope that the consent which had been given might be withdrawn.

**Salford.**—The Tramways Committee have intimated their intention to hand over to the Corporation a sum of £12,000, which they are able to afford out of the profits for the past year, in aid of the borough rate. The same amount was given at the end of the previous financial year.

**Walsall.**—The T.C. on Monday decided to expend £420 on an electrically-equipped water tank for sprinkling the tramways.

**Wolverhampton.**—The Waterloo Road section is the next to be constructed. It had been intended to lay a double line of rails from Molineux Grounds, Waterloo Road, to the terminus at Stafford Road; but it is now found that the gas mains will interfere with this course. Accordingly, at the meeting of the Town Council on Monday, it was reported that the Tramways Committee:—

In view of the two trunk mains of the Gas Co., which are laid in these roads, are not prepared to recommend the Council to lay the double line of track as authorised by the deposited plans, believing that the constant access to the mains, to which the Gas Co. are entitled, would be very detrimental to the successful working of the traffic. The borough surveyor has accordingly prepared plans showing a single line, with turn-outs from Molineux Grounds, Waterloo Road, to the terminus at Stafford Road.

This deviation from the original plan was sanctioned by the Council.

## TELEGRAPH AND TELEPHONE NOTES.

**The Emden—Vigo Cable.**—The submarine telegraph cable between Emden and Vigo, which is owned and operated by the German Marine Telegraph Co., of Cologne, will be taken over by the German Atlantic Telegraph Co. at the end of 1904 by virtue

of an agreement entered into some time ago. Thus the report for 1903, which has just been approved at the general meeting, is almost the last which will be placed before the shareholders of the Marine Telegraph Co. The report states that, in addition to two slight interruptions during 1903, there were five of a serious nature, which involved the company in considerable expense, and advantage was taken of the fault in the Channel in May to substitute a stronger cable in that locality for the cable which was in use until that time, and which had proved to be insufficiently strong for the purpose. The accounts show net profits amounting to £6,978 as compared with £2,116 in 1902, and a dividend at the rate of 3 per cent. has been declared as against nil in the previous year.

**Portsmouth Municipal Telephones.**—The borough accountant has submitted to the Telephone Committee of the T.C. the balance-sheet for the year ended March 31st, 1904. The working expenses were £3,899; repayment of principal and interest, £1,464; income, £6,588; and profit £1,225, which latter sum, added to the profit made in March, 1903, of £25, gave a total of £1,250. On the suggestion of the accountant, the Committee decided that £43 1s. 6d. be written off as bad debts, and £60 placed to reserve for further bad debts.

**The Telegraph Cable Export Trade.**—A very quiet tone continues to pervade the export trade of this country in telegraph cables and apparatus connected therewith. The shipments last month only reached a total of £45,429. The prevailing quietness is clearly shown in the returns for the four months ending with April, during which period the exports have only amounted to £289,265, which contrasts with £1,261,741 in the first four months of 1903.

**Telegraphic Interruptions and Repairs:—**

| Cables. | Interrupted. | Repaired. |
|---|---|---|
| Dominica-Martinique | May 5, 1903 | |
| St. Lucia-Martinique | May 7, 1903 | |
| Trinidad-Demerara No. 1 | Aug. 27, 1901 | |
| Cayenne-Pinheiro | Aug. 18, 1903 | |
| Anjer-Kaliandа | Aug. 2, 1902 | |
| Reissa-Issa (Yemen)-Camaran | Oct. 22, 1902 | |
| Tarifa-Tangier | Jan. 18, 1904 | |
| Closed { Nagasaki-Vladivostock | Feb. 15, 1904 | |
| Closed { Port Arthur-Chefu | Feb. 18, 1904 | |
| Foochow-Formosa | Feb. 11, 1904 | |
| **Landlines.** | | |
| Seoul-Masampo | Feb. 13, 1904 | |
| Seoul-Gensan | Feb. 13, 1904 | |
| Anju-Ping-Yang | Feb. 25, 1904 | |
| Ninguta-Vladivostock | March 2, 1904 | |
| Moulmein-Bangkok | May 3, 1904 | May 5, 1904 |
| Saigon-Bangkok | May 4, 1904 | |

**Wireless Telegraphy in the United States.**—An apparently inspired communication has been published in Germany relating to the use of wireless telegraphy in the United States. The communication states that lying off New York is the well known Nantucket lightship, which is equipped with a wireless telegraphic installation supplied by the Marconi Co. An American war vessel called up the lightship, but failed to receive a reply because the United States Navy has selected for its vessels the system promoted by the German Co. for Wireless Telegraphy of Berlin. The Government thereupon ordered, it is said, the removal of the Marconi installation from the lightship, thus giving effect to the resolutions of the International Conference which was held in Berlin last year, and which suggested the free interchange of all systems of wireless telegraphy.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Aberdeen.**—May 14th. Coal bunkers, and coal and ash conveyor. See "Official Notices" April 29th.

**Abergavenny.**—May 24th. Electric lighting of Monmouthshire Asylum. See "Official Notices" April 22nd.

**Argentine Republic.**—May 30th. Tenders are being invited until the 30th inst. by the Municipal Authorities of Buenos Ayres for the construction of an electric tramway between that city and Ortuzar, Devoto and General Urquiza.

**Ayr.**—May 20th. Boiler, buildings, engines, dynamos, switchboard, wiring, mains, &c., for the District Lunacy Board. See "Official Notices" April 22nd.

**Birkenhead.**—May 14th. Feeder and distributing mains. See "Official Notices" April 29th.

**Bolton.**—May 25th. Stores for the Electricity Department. See "Official Notices" to-day.

**Brighouse.**—May 19th. Cables. See "Official Notices" May 6th.

**Bristol.**—May 16th. One 750-KW. to 1,000-KW. single-phase turbo-alternator. See "Official Notices" April 29th.

**Canterbury.**—May 14th. 1,800 yds. of cable. See Official Notices" April 29th.

**Canterbury.**—June 1st. Boiler, piping, 300-KW. steam dynamo, switchboard and economiser. See "Official Notices" April 29th.

**Chili.**—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

**Clyde.**—May 23rd. Electric wharf cranes for the Clyde Navigation. See "Official Notices" April 22nd.

**Coventry.**—May 25th. Pipework and a 15-ton electric crane. See "Official Notices" to-day.

**Denmark.**—The Danish State Railway authorities in Copenhagen have just invited tenders for the supply of 8,500 incandescent lamps and 112,700 arc lamp carbons.

**Exeter.**—June 9th. Permanent way, overhead equipment, cables and cars. See "Official Notices" to-day.

**Glasgow.**—May 23rd. Main cables and electricity meters. See "Official Notices" April 29th.

**Hackney.**—May 26th. Electricity supply mains. See "Official Notices" April 22nd.

**Hammersmith.**—May 18th. Two 1,500-KW. steam turbines or low-speed engine generating sets, with condensers; boilers and superheaters. See "Official Notices" April 15th.

**Handsworth.**—May 25th. Lighting feeders, mains and roadwork for the U.D.C. See "Official Notices" May 6th.

**Holland.**—May 31st. Tenders are being invited until May 31st by the Municipal Authorities of Utrecht for the supply and laying of the armoured mains in connection with the municipal central electric lighting station.

**Johannesburg.**—July 4th. Cables, conductors, and accessories. See "Official Notices" to-day.

**Kilmarnock.**—May 17th. Permanent way work. See "Official Notices" April 15th.

**Kilmarnock.**—May 28th. Overhead equipment, rolling stock, station wiring, &c. See "Official Notices" May 6th.

**L.C.C.**—May 17th. Extra high-pressure three-phase board, low-pressure combined direct and three-phase ditto, substation and transformer boards for Greenwich power station. See our "Official Notices" April 15th for particulars.

**L.C.C.**—May 17th. Ten water-tube boilers with superheaters. See "Official Notices" April 29th.

**Manchester.**—May 25th. Twenty movable electric cranes, for the Ship Canal new dock works. See "Official Notices" April 29th.

**Mexborough.**—May 21st. Two 100-KW. steam dynamos. See "Official Notices" May 6th.

**Neath.**—May 16th. Electric light mains, feeder pillars, and switchboards. See "Official Notices" April 29th.

**Partick.**—May 24th. Boiler, economiser, pump, condenser, &c. See "Official Notices" May 6th.

**Pietermaritzburg.**—May 16th. Six electric tramcars. See "Official Notices" May 6th.

**Pontypridd.**—June 4th. Motors. See "Official Notices" to-day.

**Rochester.**—June 3rd. Permanent way and overhead line. See "Official Notices" to-day.

**Rotherham.**—May 31st. Cable and meters. See "Official Notices" to-day.

**Royton and Crompton.**—May 28th. Overhead equipment and cables. See "Official Notices" May 6th.

**Shanghai.**—July 30th. The Municipal Council invites tenders for a 24-mile electric trolley line concession. Particulars from J. Pook & Co., 63, Leadenhall Street, E.C., the London agents of the Council. See "Official Notices" to-day.

**Spain.**—May 31st. Tenders are being invited until the 31st inst. by the Spanish Post and Telegraph Authorities in Madrid for the establishment and working of a telephone exchange at Elche, with sub-offices at Novelda, Aspe, Monovar, Elda, Pinoso and Crevillente. Tenders are to be sent to La Direccion General de Correos y Telegrafos, 10 Carretas, Madrid, whence particulars may be obtained.

**Stretford.**—May 18th. 400-KW. steam-driven generator. See "Official Notices" May 6th.

**Sunderland.**—May 26th. Stores for the Tramways Department. See "Official Notices" to-day.

**Sunderland.**—May 27th. 500-KW. three-phase induction motor-generator for traction purposes. See "Official Notices" to-day.

**Walthamstow.**—May 20th. Tramcars. See "Official Notices" April 29th.

**Warrington.**—May 30th. Mechanical stokers and water softener. See "Official Notices" to-day.

CLOSED.

**Birmingham.**—The Corporation has just placed an order with the British Westinghouse Electric and Manufacturing Co., Ltd., for three-phase generating plant of an aggregate capacity of 3,000 KW. This will consist of one 1,500-KW. rotating field, 25 period, 5,000-volt generator, running at 166⅔ r.p.m., and three similar machines of 500-KW. each running at 250 r.p.m.

**Cambuslang.**—Messrs. Johnston, Park & Co., Glasgow, have received the contract for the electric lighting cables, the amount of the offer being £8,272.

**Gillingham (Kent).**—The T.C. has accepted the tender of the British Thomson-Houston Co., Ltd., for the supply of meters as under:—

Recording wattmeters, 100 volts, 5, 10 and 15 amperes, £1 15s.; 25 amperes, £1 17s. 6d.; 220 volts, 5, 10 and 15 amperes, £1 15s.; prepayment meters, 3 amperes, £3 17s. 6d.; 5 amperes, £4.

**Kildare.**—We understand that the Naas No. 1 Rural District Council at its meeting on 4th inst. gave the order for complete electric light generating station, mains, &c., for Kildare to the National Electric Construction Co., Ltd. As far back as April, 1903, the Council advertised for competitive plans and tenders; these when received were submitted to Messrs. Robert Hammond & Son for report. The one sent in by Mr. W. H. Clegg was considered the best, and the negotiations which followed resulted in the above company securing the whole contract. It is hoped to complete the work in four months.

**London.**—The General Purposes Committee of the London County Council have received the following tenders for the supply of 7,000 incandescent lamps of British manufacture:—

| | | | | |
|---|---|---|---|---|
| Sunbeam Lamp Co. .. .. .. .. | £235 | 10 | 5 | 2½ per cent. discount |
| Edison & Swan Co... .. .. .. .. | 237 | 14 | 2 | Net. |
| Mackey's Electric Lamp Co. .. .. .. | 214 | 11 | 8 | 2½ per cent. discount. |
| Sir Hiram Maxim Electrical Co. .. .. | 248 | 15 | 0 | " " |
| General Electric Co. .. .. .. .. | 280 | 6 | 3 | " " |

The tender of the Sunbeam Lamp Co. has been recommended for acceptance.

**Reading.**—The T.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of six bogie tramcars and an electric water cart at £4,290.

**West Ham.**—The Corporation has placed orders for three Simplex Smoke Preventers at £35 each; and with Messrs. Estler Bros. for a Harvey patent automatic electric tramway signalling apparatus at £18 10s. plus £10 for erecting.

**Wolverhampton.**—The T.C. on Monday accepted the tender of Thomas Parker, Ltd., amounting to £1,910 for two 120-KW. steam generating sets for installation at the refuse destructor; and application is to be made to the Local Government Board for their sanction to a loan of £3,000, the Finance Committee be authorised to borrow all requisite monies, and, if necessary, raise Wolverhampton Corporation Stock for the purpose of defraying the cost of the works.

## FORTHCOMING EVENTS.

Monday, May 16th.—At 8 p.m. Electrical Trades Union Smoking Concert at the Mitre, Upper Street, N. [The concert is to celebrate the opening of the new club room of the Central Branch.]

Wednesday, May 18th.—Institution of Electrical Engineers (Birmingham). Visit to the Birmingham Small Arms Works to inspect the electrical plant.

At 7.30 p.m. Institution of Electrical Engineers (Birmingham). "Motor-Starting Switches and Resistances," by Mr. F. O. Hunt.

At 7.30 p.m. Institution of Electrical Engineers (Students). Annual general meeting at 29, Victoria Street, S.W. "Some Notes on Steam Turbine Testing," by Mr. C. G. Seeley.

Thursday, May 19th.—At 8 p.m. Institution of Electrical Engineers at Society of Arts. Discussion on Messrs. Parsons, Stoney and Martin's paper, "The Steam Turbine as Applied to Electrical Engineering." A special general meeting will be held at conclusion of discussion to approve alterations in the regulations.

Friday, May 20th.—At 8 p.m. Junior Institution of Engineers. "Practical Notes on the Running of Motor Cars and Cycles," by Lieut. W. G. Windham.

At 9 p.m. Royal Institution. "The Radiation and Emanation of Radium," by Prof. E. Rutherford, F.R.S.

## NOTES.

**Leicester's Electric Tramways.**—A Board of Trade inspection was held on Wednesday last, of those routes of the new electric tramways for Leicester which are to be formally inaugurated for public use next month.

**Junior Institution of Engineers.**—Yesterday evening members of this Institution visited the works of the Great Northern Piccadilly and Brompton Railway in Brompton Road.

**Electrical News from Australia.**—A correspondent writing from Sydney under date April 5th, says that: "Things electrical are very dead here, what with bad government, droughts, &c. It is said that the City Council at Sydney will be running their plant in June next. They will supply at 480 and 240 volts three-wire continuous-current within the city boundaries, and outside at 240 and 415 volts single-phase, and 415 volts three-phase at 50 cycles. Henley's Telegraph Works Co. have the mains fairly well in hand. Messrs. Dick, Kerr & Co. have not yet got the sub-station plants here, and there may be some delay in that direction. The firm is strongly recommended for the two additional 600-KW. three-phase sets for the power house, but the matter is not yet settled. Their prices are much higher than the lowest tender.

The Christchurch (N.Z.) tramway contract has been given to a local syndicate, of which Mr. T. E. Taylor is chairman." We may supplement this information with news which appeared in the New York *Electrical Review* for April 30th, wherein it was stated that the contracts amount to £500,000, and that Mr. Taylor was on his way to the States for placing the contracts for the machinery, material, &c. It is said that Mr. F. Hubert Chamberlain, a former American General Electric man, will have charge of the construction. He was recently construction engineer of the Sydney City and Suburban Tramways.

The New Zealand Public Works Department has decided not to allow double electric car lines in streets of less than 50 ft. width. At South Dunedin the Council in complying with this has to spend £45,000 on street widenings.

In view of the inadequacy of the North Sydney Telephone service, the matter was recently brought before the Federal Council, with the result, according to the *Electrical Record*, that arrangements have been made for providing further accommodation by laying extra submarine cables and fresh lines on the North Sydney side, and the work is to be pushed forward speedily.

At Wellington (N.Z.), according to *Australasian Hardware and Machinery*, the City Council is going to extend its electric tramway system to Brooklyn, Island Bay, and Kilbirnie, at a cost of £68,611. Mr. W. R. Wright, the tramways and city electrical engineer, recommended the construction of these three branch lines.

We are also indebted to *Australasian Hardware and Machinery* for the following information:—

The firm of Noyes Bros. has presented a complete equipment for an electrical laboratory to the Adelaide School of Mines. The laboratory was opened on February 26th.

Adelaide tramways have long been a subject of discussion, and various proposals for the installation of a better system have been made. The latest was that of Mr. F. H. Snow (representing a syndicate), who offered to take over the existing trams for £400,000, and substitute an overhead electrical service on up-to-date lines. This project fell through, however, and the Government has now intimated its intention of taking up the work itself. Under the agreements with the present companies, the Ministry has purchasing powers, but it may be necessary to introduce a Bill making its rights clear, and so legalising the action contemplated. Tenders will then be called for the work of converting the trams to electrical traction on the overhead or any other practical system. Whether, after the trams are in running order, the Government will retain them in its own hands, or lease them to a company, remains to be seen.

The Jumbunna Coal Co. are now installing an electrically-driven plant, consisting of a 160-H.P. three-phase generator, direct coupled to a Belliss compound engine, which will supply power for a 35-H.P. electrically-driven winding plant and several electrically-driven pumps, besides lighting the mine and doing other work. The plant is being supplied by G. Weymouth Prop, Ltd., who will manufacture the electrical portion of the work in Melbourne, and deliver the plant complete within 12 weeks.

So far the Government have not been able to appoint an expert to report on the proposed use of electricity instead of steam on certain of the suburban railways of Victoria. It was intended, it is said, to appoint Mr. Bradford, who is connected with Noyes Bros., Australian agents for the Westinghouse companies, but other electrical firms took exception to such an appointment, maintaining that any appointee should have no connection with any firm that might have business interests at stake.

**Electrical Workers in Germany.**—It is estimated that the electrical engineering industry in Germany provides employment for 69,000 workers and officials. The Allgemeine-Union Co. and the Siemens-Schuckert Works Co. represent 24,000 out of the total, and the balance is distributed among the other works throughout the country, which number about 200. As the large firms have now nearly finished the work of reorganisation, it is expected that the question of prices, which have been depressed for a long time past, will soon receive increased attention.

**I.E.E. (Glasgow Section).**—On Tuesday evening discussion was resumed of the paper on "Telephones," read to the Section by Mr. A. R. Bennett, general manager of the Glasgow Corporation system.

**Appointments Vacant.**—Switchboard attendant for Burnley (30s.); junior assistant engineer for Watford; assistant clerk for the Woolwich electricity department (£90); clerk of works for Walthamstow and District Light Railways (£4 4s. per week).

**Third-Rail Fatality.**—It is reported that on Wednesday a child of 3½ years of age got on to the track of the North-Eastern Railway electrified section at Jesmond, and, coming into contact with the live rail, was killed.

**Single-Phase Traction with Three-Phase Generators.**—We recently referred to the equipment by the Westinghouse Electric and Manufacturing Co., of Pittsburg, on their single-phase system of a high-speed line from Indianapolis to Connersville (Ind.), which will eventually be extended to Hamilton, a total distance of 93 miles. It had been originally decided to work the latter line on the direct-current system; but the estimated first cost and running expenses of the single-phase system coming out so much lower, the engineers decided to adopt single-phase working. Although two 500-KW. three-phase generators had been placed on order for the direct-current working of the line through rotary converters, it was not found necessary to do away with these, the power station equipment, so far as the engines and generators are concerned, remaining as first laid out. The generators will develop a pressure of 2,300 volts, and this pressure will be stepped-up on the Scott system to 16,500 volts two-phase for transmission to the six transforming sub-stations, which will be located every 10 miles or so along the line. Half of these stations will be connected on one phase and half on the other, and the supply will be reduced to a trolley voltage of 3,300, transformers on the cars bringing this pressure down to the working value. The trolley wire will be No. 000 B. and S. gauge copper. Rheostatic control will be adopted, the car equipments having to be worked with direct current within the confines of Indianapolis City. The first 10 cars ordered will be each equipped with four 75-H.P. motors so geared as to develop a speed of 42 miles per hour on the level. The consulting engineers estimate that the adoption of the single-phase in place of the direct-current system will result in a saving of £100,000 on the whole line from Indianapolis through Connersville to Hamilton.

**Eliminating Hysteresis by an Oscillating Magnetic Field.**—According to experiments by Mr. Maubain, recently described before the French Academy of Sciences, the hysteresis of iron may be diminished or entirely eliminated by means of an oscillating magnetic field. In place of the well-known magnetising curve comprising two lines, a one-line curve containing all the points both for increasing and decreasing values of the field is obtained in the case of an iron or steel core submitted simultaneously to the action of a cyclic magnetic field and of another magnetic field oscillating constantly in the same direction. In order to be sufficiently penetrated by the oscillating field, the iron should be thin. The author used both tempered and non-tempered spring steel, 0·1 to 0·15 mm. in thickness and 0·2 to 1 mm. in breadth, as well as cylindrical steel and iron rods. The test pieces were surrounded by two long coils, the outer one producing the magnetising field, while the inner one, consisting of a single layer of well insulated wire, was traversed by oscillating electric currents. The magnetisation was measured by means of a magnetometer, when in the thinnest non-tempered samples the hysteresis was found to be eliminated entirely, the separation of the two curve branches becoming more and more distinct as the thickness increases. Tempered steel showed similar phenomena, though requiring stronger oscillations. The magnetisation obtained during the action of the oscillations was stronger than is usually obtained. These results were obtained when the induction coil was fed with alternating current, the induction effects being then symmetrical. With intermittent direct currents producing asymmetrical oscillations a strong magnetisation in a determined direction was produced, which persisted after the oscillation had ceased, while with primary alternating current no definite magnetisation was obtained. The non-symmetrical induction, therefore, gives a magnetising curve passing, instead of through zero, through another point characteristic of the magnetisation by oscillation.

**Action of Hertzian Waves on Feeble Lights.**—M. Gutton, in the *Comptes Rendus*, April 18th, describes experiments which prove that Hertzian oscillations, like electromotive forces induced by a varying magnetic field, can enhance the brightness of a phosphorescent screen of sulphide of calcium. Polarised waves have the strongest effect. The screen also exhibits the reflection of the waves from a plane mirror better than does a resonator. Hertzian waves, like the N-rays of Blondlot, increase the brightness of the phosphorescence, if one looks at the screen normally, but diminish the brightness when seen tangentially. In observing, therefore, it is well to place oneself in front of the screen. A strip of ground glass, illuminated by a very small gas jet, becomes brighter when it receives Hertzian waves. The phosphorescence of the sulphide also serves to show the waves in a Hertz resonator. Wire gauze is soldered to the sides of the cut or gap in the wire, and the sulphide, placed between them, is observed through the meshes.

**Niagara: Proposed Export Duty on Electricity.**—Mr. Orrin E. Dunlap, writing from Niagara Falls, says:—

Considering the vastness of the electrical power development on the Canadian side at Niagara, the question has arisen as to whether or no the Dominion of Canada shall assess an export duty on electricity generated on the Canadian side and transmitted across the river to the United States. In the franchises granted to the various power companies by the Commissioners of Victoria Park and ratified by the Ontario Government, it is provided that the power companies shall, from the electricity or pneumatic power generated, supply the same in Canada to the extent of any quantity not less than one-half the quantity generated at prices not to exceed the prices charged to cities, towns and consumers in the United States at similar distances from the Falls of Niagara for equal amounts of power and for similar uses.

In this there is an implied consent to the exportation of not more than one-half the amount of power generated, and it is fair to assume that the great works have been carried on, at least by two of the three constructing companies, under the belief that the Dominion would not interfere with the free exportation of half of the amount of power generated. Of late there has been growing a feeling along the Niagara border and among the various municipalities of Ontario within the zone of prospective benefit from the Niagara development that the Government should place an export duty of about $15 per H.P. on electric power generated in Canada and transmitted to the United States. Such a duty would be almost prohibitive in its nature, so far as the border transmission or export is concerned, and the result would be that about all the power generated in Canadian Niagara would be kept at home for the upbuilding of that locality.

While such a result would no doubt form a pleasant picture for loyal Canadians to consider, the truth is, or at least the present-day demand makes it so appear, that it will be many years before the Canadians can hope to use the enormous amount of power now contemplated to be developed in Victoria Park. Of the three companies now holding franchises, the Canadian Niagara Power Co. will develop 100,000 H.P., while the franchise of the Ontario Power Co. covers 150,000 H.P., and that of the Toronto and Niagara Power Co. 125,000 H.P., or a grand total of 375,000 H.P. Of course, it is far from likely that this amount of power will be available for many years, but should the three companies proceed as energetically as they are now doing, and develop their franchise rights to the utmost, Canadian Niagara would be simply swamped with power, if it were not possible to transmit some of it to market across the river in the United States. In fact, even with the right of such transmission, there is no demand for such a quantity of power within the zone of profitable transmission about Niagara to-day.

It has all along been pointed out that the great power plants of the Niagara Falls Power Co. and of the Canadian Niagara Power Co. would be of great and important usefulness to each other in case of serious accident to either, for the interchange of current service would simply increase the advantages offered by the constant service of the Niagara power development.

The petitions that have been circulated on the Canadian side have been extensively signed, and will be presented to the Government. What their effect will be remains to be seen, but it may be taken from what General Francis V. Greene has said, that the officials are committed to allowing a free transmission. Mr. Greene is manager of the Ontario Power Co., and he is quoted as saying:—

"There is no such probability. So I have been assured by Canadian gentlemen who are in positions to know whereof they speak. Such a course would be folly on the part of Canada. The revenue derived from the transmission of power goes to the maintenance of the park on the Canadian side. At present, the park is thus self-supporting. The Canadians have all the power that they wish. If a duty were to be levied upon the power transmitted over here, the park commissioners would simply lose that revenue which they now receive from the American franchises. Canada is well protected in this matter.

"There is a stipulation in existence which provides that if the Canadians so wish at any time they may have one-half of the power. They have no use for such an amount, so why should they not dispose of the superfluous power to the Americans? I have been absolutely assured that official and popular sentiment in Canada is strictly opposed to the placing of any such duty."

**Belgian Campaign against German Works.**—An agitation has for some time past been proceeding in Belgium against the preference which, it is contended, is given to foreign firms in connection with public contracts for the supply of electrical machinery and plant. It is argued that whereas certain countries entirely exclude Belgian tenders from consideration, or the latter are rendered out of the question owing to the operation of high tariffs, the tenders of foreign works are admitted in the case of contracts in Belgium, where the rivalry of other nations is facilitated by the moderate duties and is disastrous to the Belgian works. As instances of alleged undue preference, it is mentioned that the abortive Bill of three years ago, which proposed to authorise the construction of a high-speed electric railway between Brussels and Antwerp, contained a clause to the effect that the electrical plant could be obtained from abroad. A second case relates to the attitude of the Brussels Municipal Council in instituting a new competition between the Belgian and German works for the equipment of a large central station in that city, in regard to which the Council is still hesitating in arriving at a decision. The town authorities of Ghent are represented as a third case of favouritism towards German works in relation to a concession for the distribution of electricity; and the Commune of Saint Gilles has entrusted the execution of lighting installations to a German firm. It is stated further that the Brussels Tramways Co. will not ask Belgian works for prices for the delivery of electrical plant. The Belgian firms protest against being thrown on one side in this manner, and they complain that this treatment is of a systematic character.

**Municipal Wiring and Hiring.**—The annual meeting of the Association of Municipal Corporations had before it last week the following resolution:—

"That it is expedient that statutory powers be given to municipalities generally to sell or hire electric wires, motors, lamps, and fittings, and to fix the same on consumers' premises, and that it be referred to the Council to consider the best method of giving effect to the resolution."

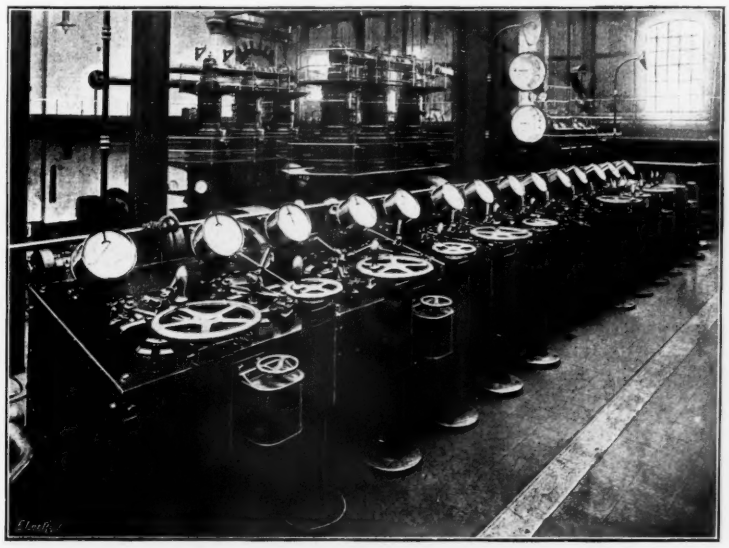
The town clerks of Wisbech and Crewe proposed and seconded the resolution, but, on the suggestion of the President, Sir Albert Rollit, the subject was included among the matters to be referred to the Council, inasmuch as the proposition raised very wide considerations.

(*Continued on page* 793.)

# THE CENTRAL ELECTRIC SUPPLY CO.'S POWER STATION.

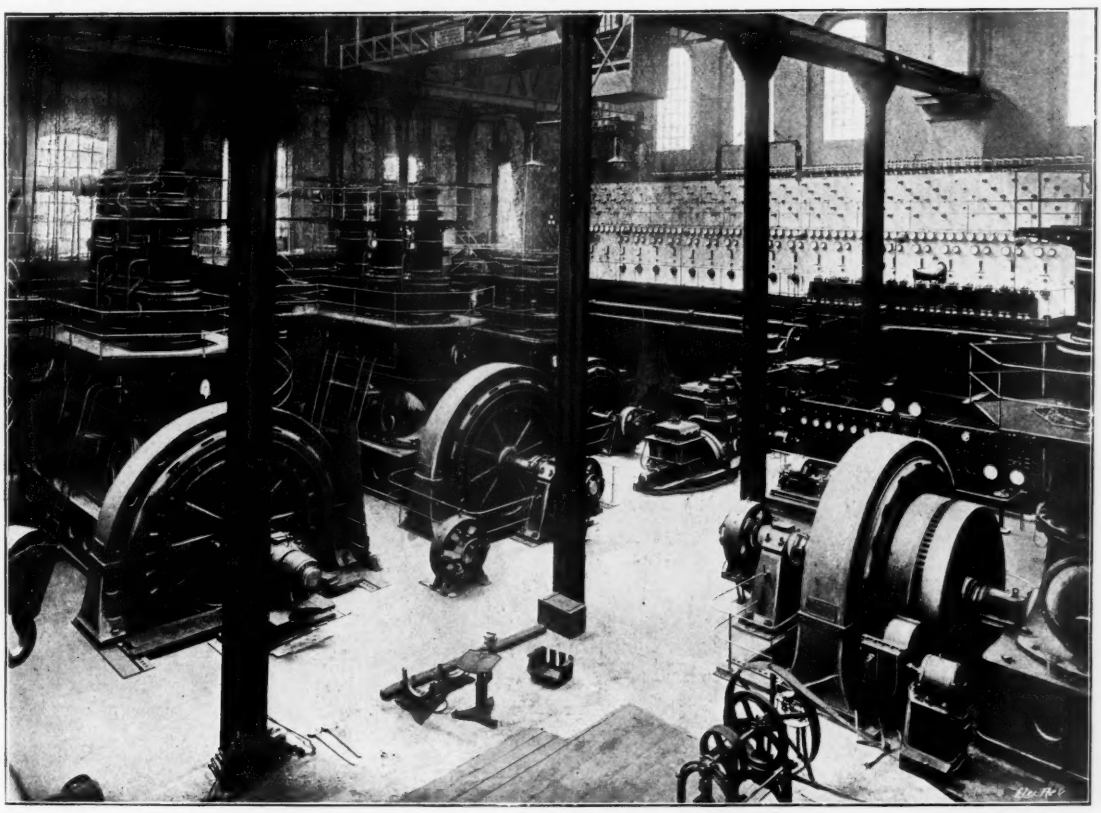
(*Concluded from page* 751.)

The engines driving alternators are all of Messrs. Willans and Robinson's well-known triple-expansion three-crank type; the larger engines run at 184 r.p.m., and the smaller at 230 r.p.m. Each engine is provided with a heavy fly-wheel and is controlled by a spring-loaded governor, with means for adjusting the speed whilst running. The governors are also fitted with small motors, which can be actuated from the main switchboard gallery to vary the speed for synchronising. The working steam pressure is 200 lbs. per sq. in. at the engine stop valves. The exhaust pipes are carried under the floor of the engine room to the base of the chimney shaft, up the inside of which a 48-in. cast-iron exhaust pipe is led to the top. The branches from the two main steam pipes are led to a common separator at each engine, which is connected with the separator by a single pipe.



Exciter Switchgear.

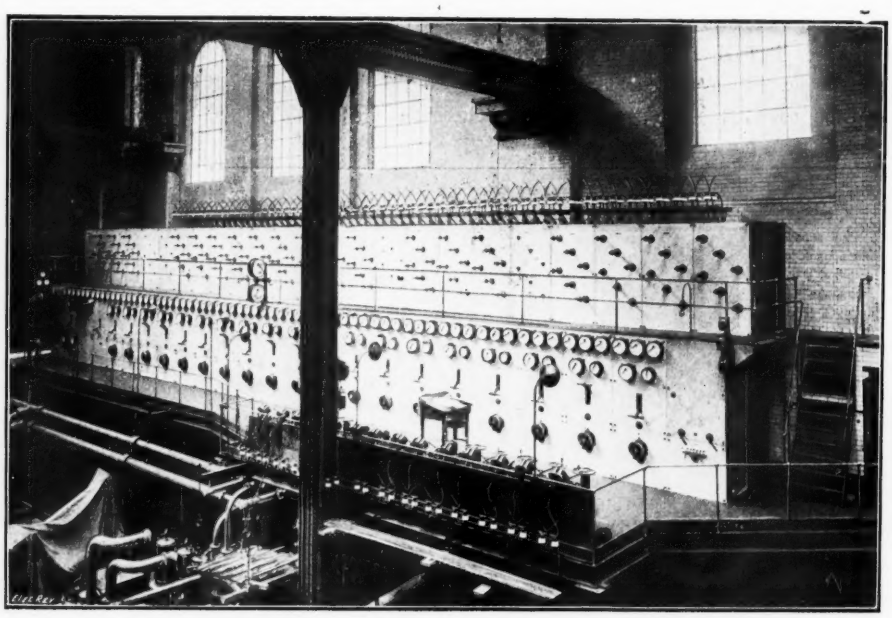
The alternators are of the Oerlikon Company's make and are star wound, but the neutral point is not earthed. The armature is carried in a substantial cast-iron frame, which can be slid sideways to clear the magnet wheel. The latter consists of a heavy ring to which the magnet poles are bolted; the large alternators have 30 poles each, and the smaller ones 24 poles. The slip rings for conveying the exciting current to the field magnets are mounted on the shaft close to the main pedestal, and the armature of the exciter, a small 4-pole dynamo, is carried on the end of the shaft outside the bearing. The field magnets of the exciter are carried



General View of Engine Room, Looking Towards the West.

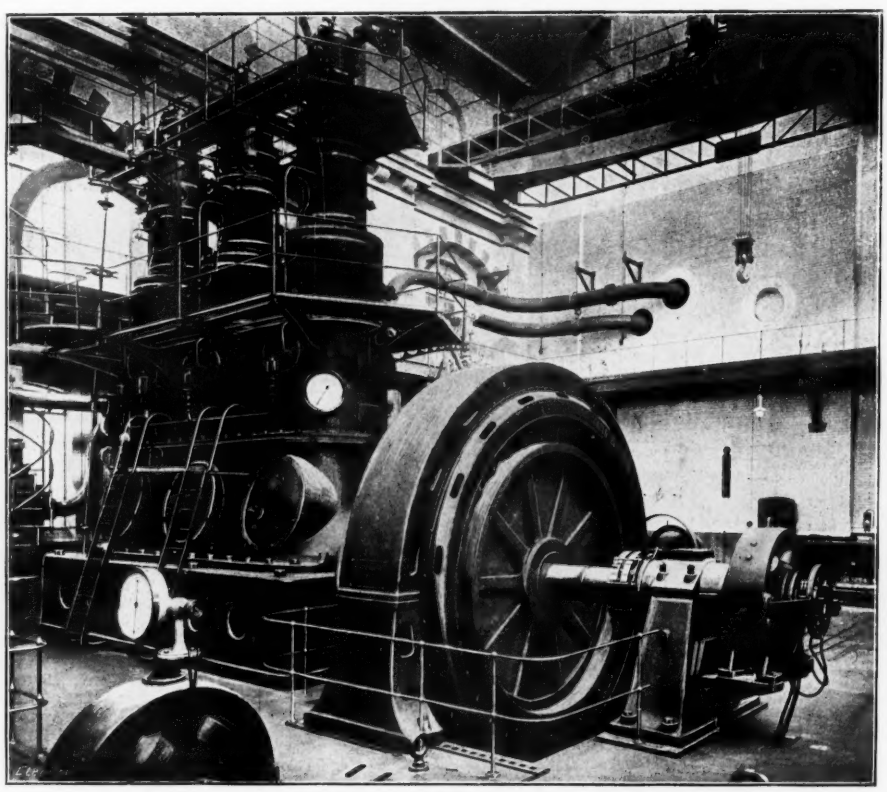
on a bracket bolted to the pedestal. The exciters work at 200 volts, the larger ones having a capacity of 160 amperes, and the smaller 80.

The light and power dynamos are of the Siemens two-pole drum type, giving 750 amperes at 200—230 volts, and are driven by Willans compound engines, at 350 r.p.m. These sets can be used when desired for exciting the alternators.



Main Switchboard.

The light and power switchboard is shown on the same illustration as the motor-alternator and booster (p. 750); it was supplied by Messrs. Siemens Bros. & Co., Ltd., and consists of nine panels of enamelled slate, as follows:—One each for controlling the booster and battery; one for excitation purposes and for dividing the D.C. bus-bars; one each for the motor-generator and for two of the dynamos; and three panels for six light and power circuits. There is also a panel behind the board for the control of the third dynamo. All the panels are equipped with circuit-breakers, ammeters and D.P. switches, and there are two voltmeters mounted over the top of the board. In front of the board are four rheostat standards, for regulating dynamos A and B, the booster, and the motor driving the latter.



Willans Engine and Oerlikon 1,260-kw. Three-phase Alternator.

All the light and power conductors are carried in Simplex tubing, installed by the works staff.

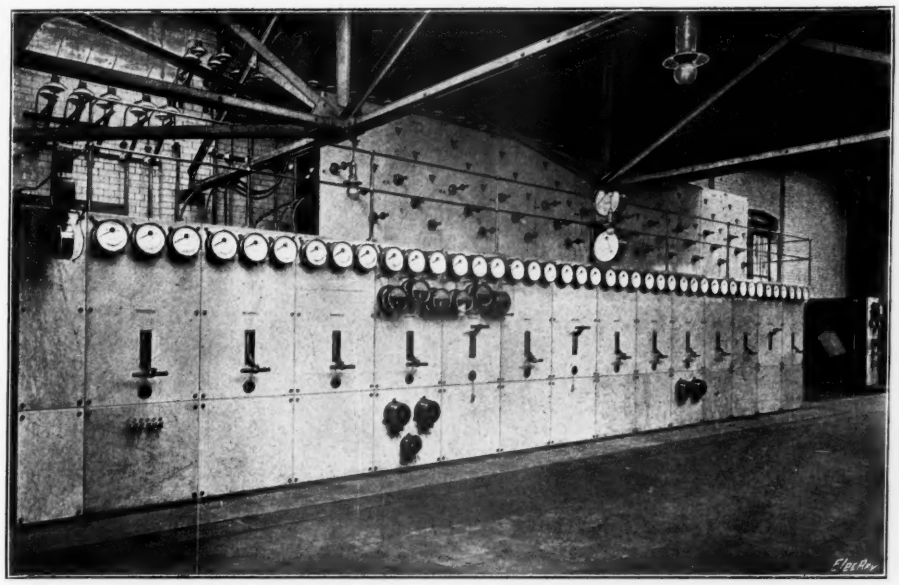
The main switchboard is mounted on a high gallery, communicating with that which runs round the engine room, and is divided into two stories, the upper being a bus-bar plug-board, and the lower the switchboard proper. The whole of the switchgear was supplied and erected by Messrs. Siemens Bros. & Co., Ltd.

The switchboard consists of 24 panels on each story, of white marble, carrying low-pressure apparatus only; all the main switches, fuses, instrument transformers and cables are carried on insulators in steel framing behind the board, and are protected by screens of wire netting. There are two sets of bus-bars, which are normally independent of one another, but can be coupled when desired. There is also a cable connector running from end to end of the board; the end panels are devoted to the terminals of this cable, which, by means of plugs on these panels, can be coupled to either or both bus-bars, forming a complete ring. The connecting cable is divided by a switch, which completes the connection after the plugs are inserted, or breaks it before they are removed.

Each generator or feeder cable is provided with a set of three horn-break spark-gaps, one side of which is earthed; these are shown in our view, over the top of the main switchboard. A long tubular water resistance is connected in circuit on the high pressure side of each spark-gap.

Passing on to the lower board, there are 7 generator and 12 feeder panels, each of which is equipped with an ammeter

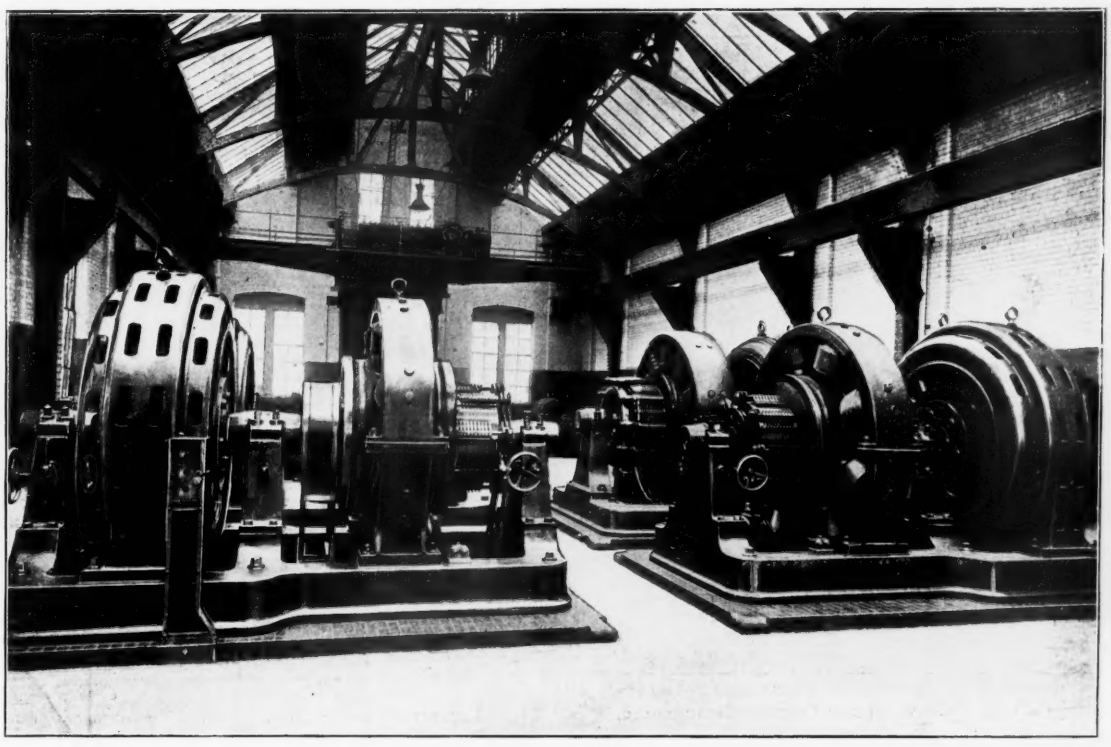
in each phase, a kilowatt-meter, and a power factor indicator, main switch and synchronising switch, and a watt-hour meter of the Ferraris induction type, which is said to give remarkably accurate readings. The remaining panels provide for the bus-bar coupling switch, ring connector switch, and motor-generator mains-charging panel, each provided with an ammeter in each phase; two earth panels, one above the other, each equipped with three Kelvin electrostatic voltmeters connected between the bus-bars and earth—these, being the only exceptions to the rule that high pressure must not be admitted to the front of the board, are protected by glass screens—and two synchronising sets, one at each end of the board, comprising each three voltmeters and a Siemens rotary synchroniser.



Carnaby Street Sub-station: High Pressure Switchboard.

The extreme simplicity of the switchgear is worthy of special notice and commendation. The wattmeter scales are provided with a back reading of 20 per cent. of the maximum, to indicate motoring in the event of such occurring for any reason. In addition to the lavish provision of ammeters on the front of the board, an ammeter is connected in circuit with one of the three phases corresponding to each panel, behind the board, so as to afford an indication that a cable is alive. The fuses are in duplicate on each cable, provision being made for the substitution of a sound fuse for a faulty one without interrupting the circuit at any time, and without handling live parts. Near the end of the board hangs a set of keys (to each of which is attached a wooden staff), and a padlock corresponding to each key. By means of these padlocks, and a similar set at the other end of each cable, a lineman can lock up both ends of a cable, and handle it with absolute certainty that the only keys with which it can be unlocked are in his own possession. The main cables from the generators are also locked up in passages in the basement.

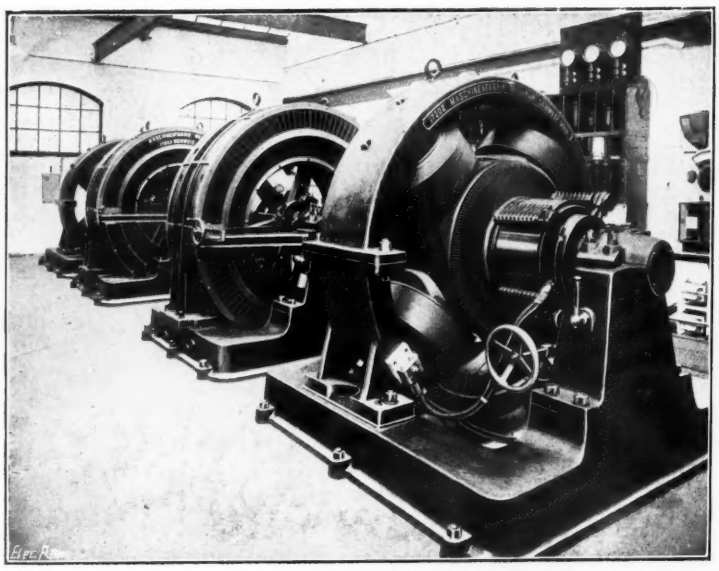
The exciter switchgear, of which we give a separate view, is completely in duplicate, and is mounted on the front of the switchboard gallery, opposite the generator panels; each set is mounted on a slanting panel of enamelled slate, and consists of two ammeters and change-over switches, two rheostat regulator standards, paralleling contacts, and a reversing switch for the governor motor. The rheostats are fixed under the switchboard gallery. The spark-gaps seen in



Carnaby Street: Motor-generators.

front of the exciter switchgear are connected with the field circuits, and are intended to discharge any abnormal rise of pressure between the terminals of the latter. The change-over switches enable the alternators to be excited either from their own exciters or from the light and power bus-bars, and two swing voltmeters are provided over the exciter switchgear to facilitate paralleling when changing over.

The feeders leaving the power station are all of Messrs. Callender's Cable and Construction Co.'s make, 3-core, paper insulated, lead sheathed and armoured, and are of 0·15 sq. in. cross-section per core, to carry 1,000 KW. each. They are laid on the solid system, in iron troughs covered with tiles. Five mains run to Carnaby Street, three to Davies Street, three to Millbank Street, and one to Eccleston Place, rooms in each of these steam-driven stations having been set aside for the three-phase plant.



ECCLESTON PLACE SUB-STATION: MOTOR-GENERATORS.

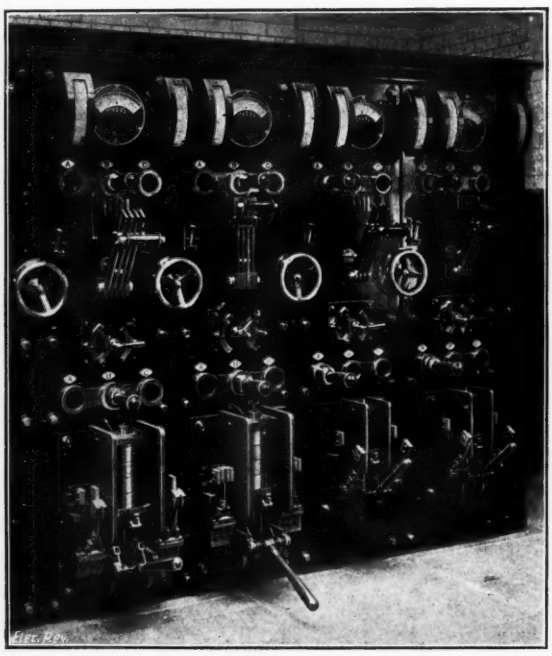
All the sub-station plant consists of induction motor-generators. The power factor of the load on the generating station is about 88 or 89 per cent. as a rule, arrangements being made for maintaining a steady and full load on such high pressure plant as may be running, while the variable part of the load is dealt with by the steam-driven plant in the stations.

As the transforming plant really forms an indispensable adjunct to a high-pressure transmission system, we have thought it desirable to add a brief account of two sub-stations, which may be taken as representative of the practice adopted by the two distributing companies.

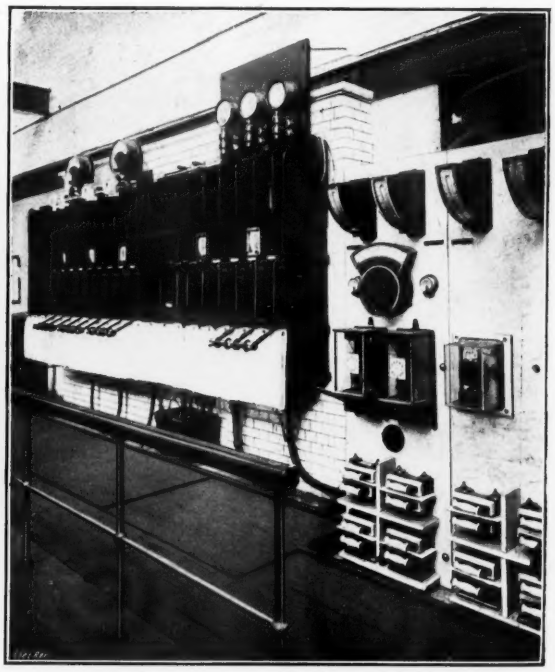
The St. James and Pall Mall Electric Light Co. has up to the present installed transforming plant having a capacity of 2,380 KW. in all, in sub-stations at Carnaby Street and Mason's Yard. We give illustrations herewith of the interior of the former, showing the motor-generators and the high and low pressure switchboards. There are four motor-generators in this station:—Two supplied by the General Electric Co., Ltd., of Oerlikon make, rated at 330 KW. each, and running at 400 r.p.m. These are shown in the foreground of the illustration on p. 791. The dynamos are coupled direct to the induction motors, and have eight poles.—One supplied by the Electrical Co., Ltd., and made by the A.E.G., of 500 KW., running at 360 r.p.m., with 10 poles.—One made and supplied by the General Electric Co., Ltd., of 300 KW., running at 388 r.p.m., with six poles.

In each case the stator of the induction motor is fed direct from the 6,000-volt bus-bars. The dynamos are shunt-wound, and work at 240—260 volts. The rotors of the Oerlikon motors are provided with internal resistances, which can be gradually cut out, and finally short-circuited, by means of a hand-wheel and gearing. The other motors are fitted with slip-rings and external resistances, the latter being metallic in the case of the G.E. Co.'s machine, and a water resistance in the case of the A.E.G. motor. In both cases the slip rings can be internally short-circuited and the brushes raised when full speed is attained. The rotors of the Oerlikon motors are fitted with fans to direct a current of air into the interior.

The transformer room is provided with a Morris and



CARNABY STREET: DIRECT CURRENT SWITCHBOARD.



ECCLESTON PLACE: HIGH PRESSURE SWITCHBOARD, &c.

Bastert electric crane, and is well lighted from the roof, being on the top floor.

The high pressure switchboard is of the same type as that in the power station, consisting of 14 marble panels, every one of which is equipped with three ammeters and a main switch. Three of the panels control feeders to Masons' Yard sub-station. The fourth panel from the left is connected with a feeder leading to the Davies Street sub-station of the Westminster Electric Supply Corporation, and is equipped with two watt-hour-meters; one of these registers energy received through this feeder, the other energy supplied, the change-over being effected by an automatic relay. By means of this feeder, either company can assist the other in case of necessity. This panel with the next carries the earth-connected voltmeters showing the insulation of the two sets of bus-bars. The next five panels control feeders 1 to 5 from Grove Road power station. The bus-bar coupling panel follows, with two watt-hour-meters registering the total input to the two sets of bus-bars respectively. Lastly, there are four panels controlling the induction motors. Two bus-bar bracket voltmeters are provided at the middle of the board, with dials on both sides. The whole of the main switchboard was supplied by Messrs. Siemens Bros. & Co., Ltd.

A testing panel, supplied by the A.E.G., is fixed in the adjoining transformer room, to control a small alternator driven by a direct current motor. This panel is fitted with a voltmeter reading to 13,000 volts, other volt and amperemeters, main switch and regulating resistances. The alternator is of A.E.G. make, and gives 55 amperes at 500 volts, 600 r.p.m.; it is used in conjunction with a stationary transformer to give 13,000 volts for testing purposes.

The direct-current switchboard is opposite the high-pressure board, and, with the exception of the instruments and automatic cut-outs, was made entirely by the works staff. It consists of 14 panels of enamelled slate, four of which have been equipped with switchgear. The bus-bars are in direct connection with those in the main generating station below. Each panel is fitted with Nalder edgewise ampere and voltmeters, and a paralleling voltmeter. By means of screw plugs any panel can be coupled to any one of three sets of bars supplying different districts. Each panel is also fitted with a positive main switch, shunt switch, and regulating rheostat handwheel. The negative switch is a maximum and reverse current cut-out, made by Messrs. Moy, Ltd. The larger cut-outs come out at 3,000 amperes forward, or 300 amperes reverse; the two smaller ones come out at 2,250 amperes forward, and are not provided with the reverse current attachment. The shunt rheostats were also provided by Messrs. Moy. The design and workmanship of the board are excellent; plenty of space is left behind it, and there are no loose cables about the back, all the cables being carried under the floor.

The ultimate capacity of this sub-station is 12 motor-generators of similar size and type to those now installed.

The remaining views show the interior of the sub-station attached to the Eccleston Place generating station of the Westminster Electric Supply Corporation, Ltd. Here there are three motor-generators of Oerlikon make, supplied by the General Electric Co., Ltd., and rated at 250 KW. each. In this case the dynamos are of the 4-pole type, and are mounted on separate bed-plates from the motors.

The high-pressure switchgear is of the standard Ferranti type, having 18 single-phase panels, three of which are spare. There is also a meter panel. The panels are arranged in threes, with the three switch handles coupled for the control of each three-phase circuit. Three sets are allotted to the motors, and two to feeders (one from Grove Road and one from Millbank station). The meter panel, at the middle of the board, carries a watt-hour meter which registers the total input, and also indicates the power taken at any instant. There is a single set of bus-bars with expanding plug connections. Three voltmeters are provided, connected between the bus-bars and earth. In front of the oil fuses in the lower part of the board asbestos mattresses are hung—a simple, but probably effective, precaution against fire.

All the direct-current switchgear and the regulating rheostats are fixed on the main switchboard in the generating station below, this sub-station, like the one just described, being on the top floor. Two marble panels in the sub-station carry edgewise ammeters and a voltmeter, Aron or Thomson watt-hour meters and switch-fuses only; these were supplied by Messrs. Kelvin & James White, Ltd., of Glasgow. The room is well lighted from the roof, and is equipped with travelling blocks and tackle.

For the present we must defer detailed reference to the other sub-stations, viz, Millbank Street with 2,000 KW. installed, Davies Street with 1,400 KW., and Masons' Yard with 920 KW., but we may mention that one is in course of construction by the Westminster Co., which will be capable of accommodating plant of 10,000 KW.; and doubtless, as time goes on, several additional sub-stations will be required by both companies.

In conclusion, we wish to express our thanks to Mr. F. J. Walker, general manager and secretary of the Central Electric Supply Co., Ltd., for facilities to obtain photographs; to Dr. A. B. W. Kennedy and Mr. Sydney T. Dobson, engineers to this and the distributing companies; to Mr. C. Stanley Peach, the architect of the Grove Road station; and to the engineering staffs at the respective stations, in particular to Mr. W. J. D. Partridge, the engineer in charge of the generating plant, whose courteous assistance in the preparation of this article has laid us under deep obligations to him.

## NOTES.

(*Continued from page* 788.)

**South African Notes.**—Our South African correspondent writes:—

*Durban (Natal).*—The acting borough electrical engineer's report for the month of March states that the total number of lamps applied for was 1,754, bringing up the total to date to 106,877. The total number of connections made was 58, which, including six for power, makes the total to date of 2,326 consumers. The number of units consumed for private lighting was 98,332, and for power 58,246. The suburban districts street lighting has been increased by the addition of 37 lamps, making a total of 767 lamps. The extensions to the mains are being rapidly proceeded with, 3·264 miles of "B.I.W." cable having been laid, and ·264 mile having been added to the overhead lighting mains. In addition to the applications for lighting, eight applications were made for 500-volt D.C. motors, totalling 70 H.P. A further 1,000 ft. of six-way earthenware conduit and 5,700 ft. of cast-iron pipe has been laid in connection with the new telephone work.

*Delagoa Bay.*—The Lourenço Marques Electric Laundry has started operations. The plant comprises a 50-H.P. boiler with a 25-H.P. engine and a 14½-H.P. electric generator, also washers, extractors, mangle, starching and ironing machines. There are patent drying rooms, and the system is in accord with the principles of the most perfect hygiene.

*Rand Mining Companies.*—The schedule attached to the directors' report of the Princess Estate and Gold Mining Co. shows the value of the general electric plant to be £11,850. The items are as follows:—Five dynamos, 10 motors, 11 switchboards, 18 lightning arresters, 520 lights, 6 spare armatures and 7 miles of wiring. There are also two electric three-throw 10-in. plunger pumps, the estimated value of which is £1,200.

The directors' annual report of the Geduld Proprietary Mines, Ltd., recently submitted in Johannesburg, intimates that "the necessary permission having been obtained from the proper authorities, the main line for the transmission of electric power from the Rand Central Electric Works at Brackpan to your property has been erected." In the balance-sheet attached to the report is the following item:—"By electric power and lighting installation, £7,500 10s. 9d." Similar references to the supply of electricity from the Brakpan generating station are also contained in the respective reports of the Central Geduld Gold Mining Co. and the North Geduld Gold Mining Co.

The value of the Central power plant on the property belonging to the Lancaster Gold Mining Co. is put down in the schedule as at December 31st, 1903, attached to the directors' report, at £48,968 16s. 8d. It is stated that a new 16,000-gallon capacity electrically-driven pump, Hoppe type, has been erected at the main pumping station at 5th level. . . . . The pumping plant and electrical appliances have been working well throughout the year.

In the schedule of the Roodepont Central Deep Gold Mining Co., attached to the directors' report, the general electric plant is valued at £12,621 7s. 11d.

Henley's (South African) Telegraph Works Co., Ltd., of Alliance Buildings, Gardiner Street, Durban, have opened an office at 3, Chorlton Chambers, Harrison Street, Johannesburg, for the sale of wires and cables for electric lighting, telephones and telegraphs. They are sending a large stock to their store in that city, immediately from the Coast, when they will be in a position to give prompt delivery to users in the Rand district. The Johannesburg house will henceforward be the head office in South Africa.

*Cape Colony.*—The electric lighting of the General Post Office, Cape Town (states the Postmaster-General in his annual report), has been satisfactorily conducted, and the plant, inclusive of lifts and motors, has been maintained in a state of high efficiency. Similarly at Kimberley there has been no hitch of any kind. It is proposed shortly to lay down an electric light installation at King William's Town, where similar benefit to that conferred on Kimberley will be experienced. The Postmaster-General further recommends the Government "to find other quarters for the telegraph school (which is on the top floor of the Post Office), in order to provide for the increase in telephone traffic. But the only possible way of permanently meeting the future requirements of Cape Town is the transfer of the whole Telephone Department to a wing of the new post office annexe, which, in another portion of the report, I have referred to as urgently necessary."

At a recent meeting of the T.C. of Cape Town, it was agreed "that it be an instruction to the Waterworks and Electric Light Committee to consider and report as to the advisability of reducing the charges made for the supply of electric light to small consumers."

*Bulawayo.*—The annual report of the Bulawayo Waterworks Committee for the year ended December 31st last, states that the electricity department has advanced steadily during the last year, "and that the number of consumers has increased as follows:—1902, 489; 1903, 549; increase of 12½ per cent." The above is the number of actual consumers, and not connections. The difference is due, of course, to unoccupied premises. The output in units during 1903 cannot be compared with that of the previous year, as the systems of returns are dissimilar. The total revenue has increased as under:—1902, £15,716; 1903, £17,908; increase, 14 per cent. The running costs have slightly increased. . . . . In consequence of the resumption of the all-night running system and the very light load existing after midnight, a small unit has just been erected, consisting of a Ruston Proctor oil engine and General Electric generator; this, it was thought, would not only be more efficient in running, but, by closing down the boilers at midnight, save not only fuel but firemen's wages. The permanent running of this unit has not yet been commenced. The whole of the plant installed has been kept in a thorough state of repair, has proved itself reliable, and is giving good results. The engine room has been slightly enlarged to provide for the new unit, and a testing shed provided. Sufficient plant and mains have now been laid down to meet the electrical requirements for some time to come."

*Johannesburg.*—The T.C. have issued a map of the municipal area, showing the proposed routes for the new electric tramways which are now under consideration. A probable future addition to the proposed north-west extension will mean a service of electric trams from a point 1½ miles to the north-west of Melville.

**Institution of Electrical Engineers.**—A special general meeting is to be held next Thursday, after the ordinary meeting, to consider a number of alterations in the Regulations relating to the presidential office. According to these, the member elected president will be styled "The President-Elect," but will not assume the reins of office until after the first ordinary general meeting of the following session, the then president remaining in office until that time. This step is evidently intended to ensure continuity of policy, in accordance with the statement made by Mr. R. Kaye Gray at a recent meeting.

**The South-Western Polytechnic.**—On Friday evening last, Earl Cadogan presented the prizes and certificates to the students of the evening and day classes at this Polytechnic, in Manresa Road, Chelsea. Mr. R. C. Antrobus, the chairman of the governing body, was in the chair. The formal opening of the new buildings, which include extensions to the electrical and mechanical laboratories, followed. The principal, Mr. Tomlinson, in the course of his report, showed that the Institute was doing excellent and progressive work, and before the proceedings terminated Mr. Antrobus, on behalf of the governing body, presented Mr. Tomlinson with an address and testimonial on his retirement from the office of principal.

**The Institution of Civil Engineers.**—The Council have made the following awards for papers read and discussed before the Institution during the past session:—A Telford Gold Medal to Major Sir Robert Hanbury Brown, K.C.M.G., M.I.C.E.; a George Stephenson Gold Medal to Mr. G. H. Stephens, C.M.G., M.I.C.E.; and a Watt Gold Medal to Mr. Alphonse Steiger, M.I.C.E.; Telford Premiums to Mr. E. W. De Rusett, M.I.C.E.; Mr. Hugh Robert Hill, D.Sc., LL.D.; Mr. Alexander Millar, A.M.I.C.E.; and Mr. T. E. Stanton, D.Sc., A.M.I.C.E.; a Manby Premium to Prof. J. Campbell Brown, D.Sc.; and a Crampton Prize to Mr. L. H. Saville, A.M.I.C.E. The presentation of these awards, together with those for papers which have not been subject to discussion, and will be announced later, will take place at the inaugural meeting of next session.

**Engineering Standards Committee.**—We are informed that a conference of tramway pole manufacturers will take place at the Institution of Civil Engineers on Thursday, June 2nd, at 2.30 p.m.

The recent electrical conference convened by the Sub-Committee on Generators, Motors, and Transformers to discuss certain points which have arisen with reference to the proposed standards for motor speeds and frequencies, and to which we referred in our issue of January last, led to such satisfactory results, and proved of such great assistance to the work of that Sub-Committee, that the Electrical Tramway Sub-Committee proposed to adopt the same course.

The Sub-Committee on Electric Tramways which is presided over by Mr. A. P. Trotter, electrical adviser to the Board of Trade, was formed at a meeting of the Electrical Plant Committee in May last year, and consists of the following gentlemen:—

Messrs. A. P. Trotter (Chairman), Philip Dawson, F. Forbes Higginson, E. R. Hill, J. H. Rider, W. Rutherford, H. M. Sayers, R. H. Scotter, A. M. Sillar, J. J. Steinitz, A. H. Walton, Leslie S. Robertson, M.I.C.E. (Secretary), and C. le Maistre, A.M.I.E.E. (Electrical Assistant Secretary).

Several sittings have been held, and a large amount of information, relating to both sectional and taper poles, has been gathered through the medium of circular letters addressed to users and manufacturers.

The replies which were received to these circulars were very carefully considered by the Sub-Committee, after which they proceeded to draft a proposed standard specification for three-section tramway poles. This conference has been convened to discuss some of the more important questions which have arisen as the result of the Committee's inquiries.

We are requested to state that the Committee will welcome any gentlemen desirous of attending to give evidence on the subject of tramway poles. Particulars of the conference may be obtained on application to the secretary, Mr. Leslie S. Robertson, 28, Victoria Street, Westminster.

**London County Council.**—At the meeting on Tuesday it was resolved to lend for electric lighting purposes the sum of £11,042 to the Battersea Council and £19,000 to the St. Pancras Council.

The Public Control Committee reported that the City Corporation had asked the Council to appoint three delegates to attend a conference at the Guildhall with reference to the proposed purchase by the Government of the undertaking of the National Telephone Co. It was decided that Messrs. Harben, Johnson and Spokes should represent the Council.

The Highways Committee stated that they had had before them an analysis prepared by the statistical officer of the accounts of the electric supply undertakings in London, together with miscellaneous statistics relating to the area of supply, capacity, output, charges, &c., of each undertaking for the year ended December 31st, 1902, in the case of companies, and to March 31st, 1903, in regard to borough council works. The information was somewhat late owing to the delay which had occurred before the publication of some of the accounts of the borough councils. The councils and the companies concerned had examined and checked the figures given in the analysis, and in nearly all cases had expressed considerable interest in the document. It was decided to place the analysis on sale at the price of 5d. per copy.

Approval was given to the expenditure by the Bridges Committee of £900 for the purchase of an additional motor-generator for use in connection with the working of the lifts at Greenwich tunnel. Plans were also passed for the erection of a cable factory at Hoxton for the Gutta-Percha Co.

**National Electrical Manufacturers' Association Dinner.**—On Wednesday last the first annual dinner of this association was held at the Hotel Cecil, and proved in every way successful. Owing to lack of space we are obliged to hold over the report till next week.

**Slackness in the Engineering Trade.**—The engineering employers on the North-East Coast have informed the men that the present state of trade does not warrant the increase of 2s. per week and 5 per cent. on piece prices, applied for recently. Meetings of the men to consider what further steps should be taken, are being called.—*Financial Times.*

**"The Motor-Boat."**—The motor-boat is to have its own special organ, the proprietors of the *Motor*, (Temple Press, Ltd., Rosebery Avenue, E.C.), having decided to publish an illustrated penny journal with the title of the *Motor-Boat*.

## OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

**Central Station Engineers.**—The staff of the Middlesbrough Corporation Electricity Department held their second annual dinner last week at the Zetland Hotel, with Mr. H. M. TAYLOR, the borough electrical engineer, in the chair. The Mayor, Councillor CHAS. DORMAN, who is also chairman of the Electricity Committee, was unable to be present, but sent congratulations to the staff upon the successful year's work of the Department. A very pleasant evening was spent and the staff showed their high musical efficiency, no doubt trained by the humming of the works dynamos. It was decided to make the dinner a regular annual event to be held in May of each year.

Morley T.C. has not passed the recommendation of the E.L. Committee that the salary of Mr. J. E. ELLIS, electrical engineer, should be increased by £50 a year. The voting was equal, and the Mayor declined to give a casting vote.

Mr. W. J. U. SOWTER, late borough electrical engineer at Dorchester, has been appointed electrical engineer at Bray.

There were 68 applicants for the post, and Mr. Hammond selected six of these for the Committee to interview. Mr. Sowter's salary will be £200. The salary of Mr. A. T. Evans, the assistant engineer, who put in for the post, has been increased to £104. Mr. Clancy, assistant engineer at Dublin electricity works, withdrew his application because the salary was reduced from the advertised amount to £200.

Burnley T.C. on May 4th, by 22 votes to 19, adopted the recommendation of the Electricity Committee that the salary of the electrical engineer (Mr. R. BIRKETT) should be increased from £400 to £450 per annum.

We regret to learn that on May 6th inst. the wife of Mr. A. J. ABRAHAM, chief assistant at Partick electricity works, passed away after six months' illness. We tender our sympathies to Mr. Abraham in his bereavement.

The Dundee T.C. on 5th inst. discussed the proposal to increase the salary of Mr. RICHARDSON, the city electrical engineer, and by 19 votes to 7 the increase was agreed to.

The Southport Town Council on May 10th resolved that the salary of Mr. BLACK, the assistant electrical engineer, be increased from £3 10s. per week to £200 per year.

**Electric Tramway Officials.**—Mr. JAMES DALRYMPLE, deputy general manager of the Glasgow Tramways, has had his salary increased to £600.

The following appointments have been made by the Stalybridge, Hyde, Mossley and Dukinfield Electricity and Tramways Board:—Mr. H. TAYLOR, chief inspector of tramways; Mr. W. AMBER, of Wakefield, station superintendent; and Mr. S. E. SHEPHERD, mains superintendent.

The Southport Council has increased the salary of Mr. KENDREW, the tramways manager, from £132 to £200.

**General.**—Messrs. Bennett & Ward-Thomas, consulting electrical engineers of Manchester, are changing the name of their firm to Ward-Thomas & Donaldson, and the business will be carried on by the existing partners, Messrs. AUBREY WARD-THOMAS and JOHN WYLIE DONALDSON.

On Thursday, May 5th, Mr. FRANK HUGH PREECE, youngest son of Sir W. H. Preece, was married to Miss Bertha Caroline Johnston, at St. Mary's Church, Wimbledon.

Mr. MARCONI sailed for New York per ss. *Campania* last Saturday. It is stated that he is to proceed to Canada to establish six wireless telegraphy stations on the banks of the St. Lawrence for the use of the Canadian Government.

From the *Electrical World* we gather that: Dr. CARY T. HUTCHINSON, of America, is in Europe on a stay of two or three months; Mr. A. M. MATTICE, chief engineer of the Allis-Chalmers Co., is in England for a brief business trip; Mr. WM. N. SCOTT, manager of the Cutter Co., of Philadelphia, is also over in Europe respecting circuit-breaker contracts with the British Admiralty and others.

By the death of Sir H. M. STANLEY, not only does London lose one of its most interesting personalities, but W. T. Henley's Telegraph Works Co. loses a director. Those who were present at that company's meeting in March last could not help noting Sir Henry's infirm condition; that he was then suffering from some severe malady was plain.

We learn with sincere regret of the death of Mr. ERNEST TALBOT, of the firm of Talbot & Stevenson, of 26, Victoria Street. Mr. Talbot was the fourth son of the late Frederick Talbot, of Smethwick, and was born in 1857. One of his brothers is Mr. Herbert Talbot, well known as chief electrical engineer under the Nottingham Corporation. About 1872 Mr. Ernest went into the office of the late Dr. John Hopkinson in the lighthouse department of Messrs. Chance Bros. & Co., and when Dr. Hopkinson went to London to start in private practice he took Mr. Talbot with him. During the whole of the late Dr. John Hopkinson's professional career Mr. Talbot was his chief assistant, and on his death he was taken into partnership by Messrs. Charles and Bertram Hopkinson. This partnership was dissolved by mutual consent at the end of last year, and early this year Mr. Talbot took into partnership Mr. David Stevenson. Mr. Talbot had suffered during the past few years from consumption, and although after spending some months in Switzerland and at a sanatorium on the Cotswold Hills he rallied sufficiently to enable him to attend to business, he gradually became weaker and expired on the 5th inst. He leaves a widow and four children. The funeral ceremony took place at Wandsworth Cemetery on May 9th.

Amongst the names of members of the Engineering and Machinery Committee of the Tariff Commission we notice those of Mr. G. FLETT, managing director of Messrs. Dick, Kerr & Co., Ltd., and the Hon. CHARLES PARSONS, F.R.S., of Messrs. C. A. Parsons and Co., Heaton, and the Newcastle & District, Cambridge and Scarborough E.L. Co.'s.

The *Times* "Deaths" column for yesterday records the death, through accidental drowning, on May 2nd, of Mr. REGINALD WOOD, A.I.E.E., of Cranney Hall, Bottisham Lode, Cambs, at the age of 41 years.

## NEW COMPANIES REGISTERED.

**J. C. Lyell & Co., Ltd.** (80,797).—This company was registered on April 28th, with a capital of £2,000 in £1 shares (1,500 preference), to acquire the business now carried on at 55, Victoria Street, Westminster, as "J. C. Lyell & Co.," to adopt an agreement with J. C. Lyell, and to carry on the business of electricians, mechanical engineers, manufacturers of and dealers in all apparatus used in the generation, distribution, supply, accumulation and employment of electricity, &c. The first subscribers (each with one preference share) are:—T. B. Harper, 15, Old Jewry Chambers, E.C., solicitor; H. E. Hill, 23, Fairmount Road, Brixton Hill, S.W., cashier; F. Hopkins, 29, Heron Road, Herne Hill, S.E., secretary; R. M. Albery, Bridge Road, Chertsey, gentleman; C. M. Murphy, 31, Victoria Road, Chelmsford, clerk; E. W. Hopton, 44, Sharp Road, Wallington, clerk; and O. Dunsing, 419, Strand, W.C., clerk. No initial public issue. The number of directors is not to be less than two nor more than five. The subscribers are to appoint the first; remuneration as fixed by the company. Registered offices, 55, Victoria Street, S.W.

**Electric Circuit Breaker, Ltd.** (80,821).—This company was registered on April 30th, with a capital of £12,000 in £1 shares, to adopt an agreement between A. Parsons and G. Hall, and to carry on the business of ironfounders, mechanical engineers, manufacturers of machinery and tools, brassfounders, metal workers, boiler makers, millwrights, machinists, iron and steel converters, smiths, hardwaremen, &c. The first subscribers (each with one share) are:—H. Mullin, 18, Vicarage Street, Dukinfield, brassfinisher; W. Clayton, 72, Albion Street, Leeds, incorporated accountant; G. Hall, 385, Rochdale Road, Manchester, engineer; A. Parsons, Cliftonville, Park View Crescent, Roundhay, shoe manufacturer; T. Taylor, 31—9, Royal Exchange, Manchester, consulting engineer; J. Hargreaves, 51, Cheetham Hill Road, Stalybridge, electrical engineer; and J. Carter, Stamford Lodge, Stalybridge, engineer. No initial public issue. The first directors are A. Parsons, G. Hall, J. Carter, and T. Taylor; qualification, 250 shares.

**Topsham Electricity Supply Co., Ltd.**—This company was registered on April 30th with a capital of £3,000 in £1 shares, to carry on in Devonshire or elsewhere in the United Kingdom, the business of electricians and suppliers of electricity in all its branches. The first subscribers are:—T. J. Holman, Exedene, Topsham, master mariner, 100 shares; A. A. Amos, The Elms, Topsham, insurance manager, 5 shares; G. S. H. Smith, Strand, Topsham, 3 shares; T. J. Mogridge, The Cottage, Altamira, Topsham, gardener, 5 shares; C. J. Gale, Gore Street, Topsham, confectioner; T. E. Hopewell, Topsham, ironmonger, 5 shares; and C. F. Gale, Fore Street, Topsham, builder, 5 shares. Minimum cash subscription, 10 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than seven; the first are T. J. Holman, A. A. Amos, and C. J. Gale; remuneration as fixed by the company.

**Electric Light Insurance and Maintenance Co. (1904), Ltd.** (80,801).—This company was registered on April 28th, with a capital of £5,000, in £1 shares, to acquire the business heretofore carried on by the Electric Light Insurance and Maintenance Co., Ltd., to adopt an agreement with the Sir Hiram Maxim Electrical and Engineering Co., Ltd., and to carry on the business of electricians, mechanical engineers, suppliers of electricity for light, heat, motive power or otherwise, to construct, fix and insure the maintenance of cables, wires, lines, accumulators, lamps and works, &c. The first subscribers (each with one share) are:—F. H. Crowley, 138, Kingston Road, Ilford, gentleman; H. Moore, 61, Fore Street, E.C., commissionaire; B. L. Barnes, Hillside House, 2, Magdala Road, Highgate, N., clerk; D. Cleary, "Tralee," Napier Road, Wembley, gentleman; Esther Enticott, 14, Copthall Avenue, E.C., clerk; R. Payne, 14, Copthall Avenue, E.C., chartered secretary; and O. Steele, Sunbury, Grove Park, Lee, S.E., clerk. No initial public issue. The subscribers are to appoint the first directors.

**Wallace Lamp Syndicate, Ltd.** (80,790).—This company was registered on April 27th, with a capital of £35,000 in £1 shares, to acquire certain patents for the manufacture of electric lamps or parts thereof, to adopt an agreement with G. Wallace, and to carry on the business of electric lamp manufacturers, electrical and mechanical engineers, electricians, manufacturers and makers of dynamos, motors, apparatus, and fittings, suppliers of electricity for light, heat, motive-power, or otherwise, &c. The first subscribers (each with one share) are:—L. G. Mortimer, 1, Gresham House, E.C., merchant banker; L. G. Gordon, Queen Anne's Mansions, Westminster, S.W., civil engineer; H. G. Palmer, 1, Gresham House, E.C., merchant banker; J. W. Rogerson, 101, Leadenhall Street, E.C., merchant; G. H. Palmer, Heywood Park, Maidenhead, director; A. Holt, 2, Whitehall Court, S.W., South African merchant; and C. J. Browning, 43, Denmark Villas, Hove, secretary. No initial public issue. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first.

**Hope-Smith Electrical Co., Ltd.** (5,595).—This company was registered in Edinburgh on April 27th, with a capital of £3,000 in £1 shares, to take over as a going concern the business of E. P. Smith, engineer, of 1, Forth Street, Edinburgh, and to carry on the business of electrical, mechanical and general engineers, &c. The first subscribers (each with one share) are:—E. P. Smith, 23, Hillside Street, Edinburgh, electrical engineer; W. Spence, 7, Yardheads, Leith, electrical engineer; W. Massey, 58, Montgomery Street, Edinburgh, electrician; T. Yeates, 16, Marchinont Crescent, Edinburgh, traveller; W. Donaldson, 27, Alderbank Terrace, Edinburgh, clerk; D. Hope, Glebe Bank House, Dalkeith, engineer; and J. Hope, jun., Glebe Bank House, Dalkeith, brassfounder. The number of directors is not to be less than two nor more than five; the first are J. Hope, jun., and E. P. Smith; qualification, five shares; remuneration as fixed by the company.

**Tavistock Lighting, Coal and Coke Co., Ltd.** (80,777).—This company was registered on April 26th, with a capital of £15,000 in £5 shares, to acquire, as from December 31st, 1903, the business of the Tavistock Gas, Coke and Coal Co., Ltd. (incorporated in 1857), to make, generate, accumulate, store, distribute, sell, and supply light (either electric, gas or both) in Tavistock, Whitchurch, or elsewhere in Devon. The subscribers (each with one share) are:—W. W. Matthews, Tavistock, solicitor; J. K. Hamilton, Tavistock, gentleman; G. Williams, Tavistock, manufacturer; H. Blatchford, Tavistock, surveyor; J. Shamrock, Tavistock, accountant; S. P. Haddy, Tavistock, registrar of births and deaths; F. Jackman, Tavistock, cashier. Minimum cash subscription 25 per cent. of the shares offered to the public. The number of directors is not to be less than five, nor more than seven; the first are H. T. Doble, A. Bate, S. Nosworthy, F. Pethybridge, J. Dennis, J. Friend, and T. Doidge; qualification of subsequent directors, £50; remuneration, £35 per annum, divisible. Registered office, The Gas Works, Tavistock.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**City of London Electric Lighting Co., Ltd.** (34,406).—This company's annual return was filed on April 18th, when 40,000 preference and 70,586 ordinary shares had been taken up out of a nominal capital of £1,200,000 in 40,000 preference and 80,000 ordinary shares of £10 each. £1,105,950 has been paid. Mortgages and charges: £700,000.

**Charing Cross and Strand Electricity Supply Corporation, Ltd.** (29,124).—This company's annual return was filed on March 10th, when 70,000 preference, 70,000 ordinary, 80,000 "City Undertaking preference," and 70,000 "City Undertaking ordinary" shares had been taken up out of a nominal capital of £2,100,000 in 130,000 preference, 130,000 ordinary, 80,000 "City Undertaking preference," and 80,000 "City Undertaking ordinary" shares of £5 each. £5 per share has been called up on 70,000 preference, 70,000 ordinary, and 80,000 "City Undertaking preference" shares, resulting in the receipt of £1,100,000. £350,000 is considered as paid on 70,000 "City Undertaking ordinary" shares. Mortgages and charges: £400,000 4 per cent. debenture stock and £400,000 "City Undertaking" 5 per cent. debenture bonds.

**Chelsea Electricity Supply Co., Ltd.** (20,468).—This company's annual return was filed on April 14th, when 44,436 ordinary, 6,000 preference and 500 founders' shares had been taken up out of a nominal capital of £400,500 in 74,000 ordinary and 6,000 ordinary shares of £5 each, and 500 founders' shares of £1 each. £5 per share has been called up on 37,770 ordinary and 6,000 preference shares, resulting in the receipt of £218,850. £33,830 is considered as paid on 6,666 ordinary and 500 founders" shares. Mortgages and charges: £150,000 debenture stock and £800 "buildings."

**Crystal Palace District Electric Supply Co., Ltd.** (18,532).—This company's annual return was filed on February 27th, when 47,859 shares had been taken up out of a nominal capital of £75,000 in £1 shares. £1 per share has been called up and paid on 2,859, and 45,000 are considered as fully paid. Mortgages and charges: £60,000.

**Direct Spanish Telegraph Co., Ltd.** (6,732 C).—This company's annual return was filed on April 13th, when 12,931 ordinary and 6,000 preference shares had been taken up out of a nominal capital of £95,000 in 13,000 ordinary and 6,000 ordinary shares of £5 each. £5 per share has been called up, resulting in the receipt of £94,655. Mortgages and charges: £30,000 4½ per cent. debentures.

**Woking Electric Supply Co., Ltd.** (46,175).—Issue, on April 9th, of £950 4½ per cent. debentures, part of series created November 2nd, 1899, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £22,600.

**George Moritz, Ltd.** (38,158).—This company's annual return was filed on April 15th, when 1,009 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £9 has been received, and £1,000 is considered as paid. Mortgages and charges: £1,000.

## ELECTRICITY SUPPLY ACCOUNTS.

### City of London Electric Lighting Co.

The returns of the City company during the past year show a largely increased lamp connection over the previous 12 months, possibly due to the stimulating effects of healthy rivalry. The output has reached 13,596,000 units, and this is accompanied by a decrease in average working expenditure. The revenue, however, is somewhat less than last year, due apparently to reductions in price of supply.

The charges are: For private lighting, 8d. and 2d. per unit, based on lamp connections (summer and winter rates); power, 2½d. and 1d. per unit, maximum demand; public arclamps, £26 per annum each. The chief engineer is Mr. Frank Bailey.

GENERAL STATEMENT.

| For year ending December 31st— | 1903. | 1902. |
|---|---|---|
| Total capital expended ... ... ... | £2,037,237 | £1,956,208 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 13,596,075 | 12,988,615 |
| Public lighting ... ... ... ... | 1,210,374 | 1,152,814 |
| Total number of units sold ... | 14,806,449 | 14,141,429 |
| Equivalent No. of 8-c.p. lamps connected | 640,685 | 574,158 |
| No. of consumers connected... ... ... | 11,197 | 10,988 |
| Maximum load in kw. ... ... ... | 13,780 | 13,378 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £242,101 | £249,294 |
| „ expenditure ... ... ... | £108,484 | £118,174 |
| „ profit ... ... ... ... | £133,617 | £131,120 |
| Average inclusive price obtained per unit— | | |
| Private lighting ... ... ... | 4·02d. | 4·05d. |
| Public lighting ... ... ... ... | 2·71d. | 2·76d. |

REVENUE ACCOUNT FOR YEAR ENDING DEC. 31ST, 1903.

| | |
|---|---|
| Gross revenue ... ... ... ... | £242,101 = 3·92d. per unit. |
| Works and distribution costs (including public lighting) ... ... ... | £71,647 = 1·16d. „ |
| Total working costs ... ... ... | £108,484 = 1·76d. „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on debenture ... ... ... ... | £31,825 |
| Dividends ... ... ... ... ... ... | 56,333 |
| Reserve account ... ... ... ... ... | 45,000 |
| Redemption and superannuation funds ... ... | 1,981 |
| Balance carried forward ... ... ... ... | 21,881 |
| Balance brought forward from last account | —23,403 |
| Gross profit ... | £133,617 |

### The Chelsea Electricity Supply Co., Ltd.

We give herewith the accounts of the Chelsea Co. for the past year. It will be seen that an all-round improvement has occurred on the previous year's results, 481,793 more units having been sold than in 1902, and the lamp connections reaching 195,235. In the matter of working costs the present year's figure places the company in a very favourable position compared with other London concerns.

During the past year further expenditure has been incurred on the change-over in voltage, and added to the suspense account in connection therewith.

The prices charged are: For private lighting, 6d. and 3d. per unit, and power, 3d. and 2d. per unit, both on the maximum demand system. The chief engineer is Mr. P. Still.

GENERAL STATEMENT.

| For year ending December 31st— | 1903. | 1902. |
|---|---|---|
| Total capital expended ... ... ... | £444,025 | £419,991 |
| Number of units sold— | | |
| Private supply ... ... ... ... | 2,739,352 | 2,257,559 |
| Equivalent No. of 8-c.p. lamps connected | 195,235 | 176,002 |
| Maximum load in kw. ... ... ... | 2,405 | 2,153 |
| Revenue account— | | |
| Gross revenue ... ... ... ... | £54,774 | £50,387 |
| „ expenditure ... ... ... | £21,719 | £21,625 |
| „ profit ... ... ... ... | £33,055 | £28,762 |
| Average inclusive price obtained— | | |
| Private lighting ... ... ... | 4·8d. | 5·34d. |

REVENUE ACCOUNT FOR YEAR ENDING DEC. 31ST, 1903.

| | |
|---|---|
| Gross revenue ... ... ... | £54,774 = 4·8d. per unit. |
| Works and distribution costs (including public lighting) ... ... ... | £14,209 = 1·24d. „ |
| Total working costs ... ... ... | £21,719 = 1·90d. „ |

PROFIT STATEMENT.

| | |
|---|---|
| Interest on loans, shares, &c. ... ... ... | £20,835 |
| Renewals and depreciation fund ... ... | 9,724 |
| To suspense account (change-over of voltage) | 1,607 |
| Balance carried forward ... ... ... | 1,200 |
| Balance from last account ... ... ... | — 312 |
| Gross profit ... | £33,054 |

## CITY NOTES.

**Edison & Swan United Electric Light Co.**—The extraordinary meeting respecting the proposal to reduce the capital (as announced on page 758 of our last issue) was held on Wednesday. The resolution approving the reduction was carried unanimously.

### Cuba Submarine Telegraph Co.

The sixty-fifth ordinary general meeting of the shareholders of this company was held on the 4th inst. at the offices, 58, Old Broad Street, Mr. Charles W. Parish in the chair.

In proposing the adoption of the report, the Chairman said it would be noted that the accounts dealt with the latter half of the past year. The traffic receipts amounted to £16,205, which was £2,508 more than was earned in the corresponding period of 1902, when the traffic receipts amounted to £13,697. The greater part of that increase was due to their having had the temporary advantage of some of the French company's traffic, owing to its own direct cable between New York and Haiti being broken. That cable, which had only recently been brought into work again, broke during April of last year, so they might consider that they had profited for 12 months owing to that accident, and that they must not expect to earn quite so much under normal conditions. Their receipts from investments amounted to £2,430, making a gross income of £18,643. The expenses amounted to £5,810, and, after placing £5,000 to the reserve fund and £5,000 for payment of the dividend on the preference shares, they were able to propose a dividend at the rate of 5 per cent. per annum on the ordinary capital. During the latter half of 1902 the working expenses amounted to £6,100, or £240 more than for the past six months. Their 1875 cable between Cienfuegos and St. Santiago became interrupted last December, and the repairing steamer which the Mexican Telegraph Co. was good enough to hire to them failed to restore communication. Their own engineer was also on board the steamer, but although every means were tried for some weeks, they could not restore the communication. That was most unfortunate, for it had made it necessary for a new cable to be laid in the autumn, and the expenses of the repairing ship and the new cable would amount to £60,000. He must congratulate the shareholders that they had built up such a large reserve fund as would enable them to meet that outlay, and still leave the company in a very strong financial position. The life of cables was always uncertain, but he did not think they had any cause to grumble in this case, for the cable had done them very good service for nearly 30 years. The new cable was to be laid by Messrs. Hoopers, and when it was laid he believed it would be found that they had got an exceedingly good cable. In conclusion, the chairman stated that the outstanding claims which the company had against the United States Government for payment for the cost of repairing the damage done to the cables during the Spanish-American war, and against the Cuban Government for payment of the subsidy for the coast cables, were still unsettled. They looked forward before long to a satisfactory settlement with the United States, and he also hoped that President Palmer would soon decide in their favour on their Cuban claim.

Mr. George Keith seconded the motion, and the report was adopted.

### Calcutta Electric Supply Corporation.

Col. A. J. Filgate, R.E., presided at this company's meeting, held at Salisbury House, E.C., last Friday. In moving the adoption of the report (see p. 756 of our last issue), he said that, taking into account the large capital expenditure which they were forced to incur to deal with their expanding business, the results arrived at were very satisfactory. At the end of 1902 the number of houses on the system was 965, and the lamps and motors connected were equivalent to 80,762 8-c.p. lamps, while, at the end of 1903 the

customers had increased to 1,379, and the lamps and motors connected reached the equivalent of 121,878 lamps. The demand for current was increasing steadily. Practically all new houses built in the European portion of the city were being wired for light and fans by the builders, and there has been a good demand among the native community, especially in the northern quarter. There had also been an increased demand for power for working small workshops, printing presses, &c. The capital outlay during the year amounted to £87,116, bringing the total up to £382,770. They had erected and paid for the boilers and plant alluded to last year, and the plant capacity had been increased from 1,425 KW. to 3,239 KW., and the boiler power had been correspondingly increased. They had also sent out spare parts for the two 750-KW. Crompton-Belliss sets, and four chain-grate stokers, from which considerable economy in coal was expected. On mains they had expended the large sum of £55,850, chiefly in the northern section of the town; they had constructed 6¼ miles of overhead mains and 23¼ miles of underround mains, increasing the system to 45¼ miles of overhead mains and 63 miles of underground mains. The greater part of the extensions were not completed until after the hot season, so they did not add much to the income last year. The policy of the board was to construct mains wherever they were likely to produce a good return. It was probable that their outlay on mains would be heavy for some time to come. They had expended £5,554 on meters, and £912 on fans to meet the demands of new customers, and £6 611 on electrical instruments, chiefly on the switchboard at the Alipore station and additions to the switchboard at the Emambagh station. 2,044,681 units were supplied, against 1,552,775 in 1902. The receipts from sale of electricity amounted to £42,663, meter rents to £1,855, hire of fans and motors £2,180, and altogether the gross revenue, including dividends on investments, reached £47,139, compared with £35,124 realised in 1902, an increase of £12,015. The outlay on generation and distribution of electricity amounted to £10,256, compared with £9,431 in the previous year. Considering the large increase in the output, the increase was small. For the comparative reduction in the cost of working, they were much indebted to the care and attention devoted to the business by Colonel R. E. Crompton, their consulting engineer. The outlay on repairs and maintenance had amounted to £2,574, compared with £3,247 in 1902, a satisfactory reduction of £673. In 1902 a considerable amount of damage was done to the machinery and mains by lightning and other causes. In 1903 no serious damage was incurred, and under Colonel Crompton's advice they had protected the mains more efficiently against lightning. They had strengthened a considerable length of overhead mains, and had substituted underground mains for overhead in some streets where the load was heavy and the mains were subject to damage from branches of trees; these changes would tend to reduce outlay on maintenance. They had set aside £8,500 to repairs and maintenance, and had increased the credit balance under renewals fund account to £15,278. Management expenses had amounted to £5,438, compared with £4,968 in 1902. The total expenditure of the year, including the appropriation to the renewals fund, had amounted to £25,551, against £21,990 in 1902, an increase of £3,561. They hoped to make further economies in working combined with increased efficiency. Their final dividend (at the rate of 8 per cent. for the half year) made, with the interim dividend, 7 per cent. for the year, and £2,482 was to be carried forward. The reserve account remained at £35,000, the same figure as entered in the accounts of 1902, and with £15,278 at the credit of the renewal funds account the total reserves stood at £50,278. This would be further increased by the premiums on the new issue of shares this year. While they were obliged to incur heavy capital expenditure, it seemed the best policy to utilise the reserve account balances in their own business. During the first quarter of this current year they had delivered 511,514 units to their customers compared with 337,549 in the first quarter of 1903, an increase of 174,965 units, or over 50 per cent. No progress had been made in obtaining the lighting of any portion of the streets, but they hoped this might come later. To meet the capital outlay they had to carefully consider the position of their finances, and as the money market was not in a favourable condition for new issues last autumn, they made arrangements with their bankers for a temporary advance on satisfactory terms. Early this year an issue of £20,000 new £5 shares was made at £1 premium, all of which had been placed. He mentioned last year that the company had obtained the concession for the supply of electricity to Howrah. At one time the directors contemplated combining this supply with the working of tramways in that town, but they finally came to the conclusion that they had enough to do in their own line of business. They, therefore, took up the project for Howrah with their consulting engineer, and on his recommendation had decided to adopt gas engines as motive power. The project for this station had been matured, and the plant had been ordered, and the plans and specifications had been sent to India with instructions to proceed with the buildings. They were given to understand that gas engines would be found very suitable for a small installation such as they proposed to establish in Howrah. Last year he mentioned that they had acquired a site for a new station at Ultadanga, at the northern end of the city, and the designs and equipment for this station were under consideration. As this station was likely to become a very important factor in their system, considerable time was devoted to investigating all the latest improvements with a view to getting the best results, while at the same time securing economical working. Colonel Crompton recommended the adoption of Parsons turbines as the motive power, and they had placed an order for the initial equipment. In view of the rapid expansion of their business in the northern section of the city, this station would ere long become an urgent necessity. They had applied for a licence for supplying electricity in Hastings, which was really a portion of Calcutta.

The motion was seconded by Mr. E. BOULNOIS, M.P.

Mr. KITCHIN criticised the board's action in investing its reserve fund in the business of the company.

The CHAIRMAN having replied, the motion was carried. Dividend resolutions, re-election of directors, and other similar business having been approved, the meeting came to an end.

## Brush Electrical Engineering Co., Ltd.

LORD VAUX OF HARROWDEN presided at the annual meeting held at Salisbury House, E.C., on Tuesday. In moving the adoption of the report, which appeared in our issue of May 6th, he said that the accounts for the year 1903 showed that substantial progress had been made. The increase in overturn had been considerable, while the standing charges had advanced but slightly. The enlarged output, however, had brought with it greater direct expenditure for initiating and securing business, and this, coupled with the fact that competition had been keen and lower prices had ruled than in the previous year, had prevented the balance of net profit from advancing in the same ratio with the larger volume of business. The net profit of £28,057 which remained after paying interest on the debenture stocks, after placing £6,500 to depreciation fund, and after paying all charges, was substantially better than that of the previous year, and would be sufficient not only to pay the preference dividend for the year in full, as was recommended, but also to provide a dividend on the ordinary shares. But the directors thought it more prudent to strengthen the general reserve fund, especially as the increased business which the company was doing made it necessary to carry much larger stocks of raw materials and finished parts in order to ensure prompt deliveries. The competition in the electrical industry at the present time rendered it well-nigh impossible to deal with the business satisfactorily unless the demands for prompt delivery were complied with. An increased volume of orders meant, in addition to heavier stocks, a larger amount of work in progress, involving a greater lock-up of capital, a requirement which could be provided for by fresh issues so long as the shares were at a discount on the market. In view of all these circumstances, therefore, the board considered that they were acting in the best interests of the shareholders in husbanding the resources of the company. After referring briefly to the items of increase in the profit and loss account, such as salaries, insurance, &c., the chairman turned to the balance-sheet, which showed that the additions to property account for the year amounted to £19,613. As a matter of fact, only a portion of this represented expenditure on new buildings and plant, the remainder being for land secured in connection with a tube railway scheme on which the company was engaged. The works were already excellently equipped with modern tools, and practically the whole of the additions under this head for 1903 were represented by special machinery required for the proper and economical construction of new designs of engines, electric generators and motors, which they were now building. The items of stock and debtors both showed increases, and, similarly, on the other side of the balance-sheet the figures representing loans and creditors were up. These increases, again, were due to the larger business of the company, and were not disproportionate to the present turnover. The disappearance of the item "Depreciation Reserve Fund" from the credit side of the balance-sheet perhaps required a word of explanation. When this fund was started, the idea was to have a liquid fund that would be readily realisable in case of emergency. This necessarily meant investment in Government, corporation and other stocks, for which there was an everyday demand, but which, unfortunately, only yielded a low rate of interest. Inasmuch as the increase of the business called for more working capital, the directors felt that it would be bad finance to retain those securities bringing in only 2½ per cent., 3 per cent. or 3½ per cent, while they had to pay a higher rate of interest on money borrowed from their bankers. They had therefore been realising these particular securities and using the money for working capital—the money, in fact, was being invested in their own business instead of in outside stocks, and under the circumstances, he was convinced that this was good policy and to the company's advantage at the present time. Only a portion of the securities in question had been realised at December 31st, and the remainder had been merged under the general head of shares and debentures, which accounted for the increase of that item from £139,757 to £152,445. This item of shares and debentures was now a very considerable one, and while the securities were bringing in good dividends, they felt that the money represented by these investments could be employed to greater advantage in their manufacturing and contracting business, and they would lose no opportunity of realising as suitable opportunities occurred. With regard to the items patents and goodwill, as had been pointed out over and over again, the balance-sheet figure for patents and goodwill was not a valuation, but was the amount at which the items stood in the books. The auditors referred to the fact that certain patents had been dropped; but, on the other hand, some valuable patent rights had been acquired by the company. By building up the general reserve fund, they strengthened the position of the company, and he hoped that the shareholders would endorse the recommendation of the board to increase the fund by adding £7,000 out of the year's net profits. The car and truck departments had received a large share of attention during the year, and the company enjoyed a reputation in this branch second to none in this country. Their truck shop was only started three or four years ago, and as American-made trucks had up to that time been used almost exclusively here, there was much leeway to make up and some prejudice to overcome. The department, however, had been developed with energy and foresight. Their cars and trucks were in regular demand for the Colonies, and latterly they had succeeded in securing contracts on the Continent and elsewhere, notwithstanding the high protective tariffs against which they had to

contend. They were losing no opportunity of finding and opening up new markets for their manufactures. He stated last year that they were embarking in the manufacture of an improved type of reciprocating steam engine and had also started to build steam turbines. They had previously been engaged in the manufacture of a high-speed engine known as the "Universal," which, while possessing features of value and originality, did not meet with a sufficient amount of favour to justify them in continuing to build it. They had, therefore, given up the manufacture of the Universal engine entirely, and had adopted instead, the reciprocating type he had mentioned, which was designed on well tried principles, and was similar in its general construction and details to other engines of the same class which are very largely used in the electric lighting and power stations to-day. Before pushing the sale of this new engine they had satisfied themselves, by exhaustive and prolonged tests, that it was in every respect thoroughly satisfactory, economical and reliable. They had already made good headway both with it and with their steam turbine, and now had a number of contracts for machinery of this class in hand. The sales of direct and alternating current motors, transformers, and other electrical apparatus of their manufacture had also improved, but the works were capable of a greater output than they had yet reached. The contract and warehouse departments started some little time back had added to their profits and were now well established. As regards the automobile department, the wretchedly wet season of last year had a bad effect on the sales, and it was, perhaps, not surprising that the results of that particular department had fallen short of expectations. However, a short spell of fine weather invariably brought in an increased number of inquiries and orders for motor-cars, and he hoped that the better start they had had this year would continue. They recognised that with a growing and frequently changing industry such as theirs, it was impossible yet to settle down to standards in the same way as had been found practicable in some other branches of engineering work, and that to keep in the front rank it is necessary to be constantly on the alert to take advantage of new discoveries and improvements and often to abandon without hesitation designs or types by which the march of progress had been rendered antiquated or obsolete. At the same time, standardisation was the keynote to economical manufacture, and it was their endeavour to realise it so far as was consistent with efficiency. In their business they were subject to the fact that large orders and contracts came in at unequal periods, and to this extent acted as a disturbing factor in the general run of trading. The ideal state, of course, would be a regular flow of orders to keep the various departments going constantly at their maximum capacity, and while he was afraid they could not expect to attain to this, they desired at least to get as near as they could to it, and were giving constant attention to the arrangements necessary for the proper representation of the company, both at home and abroad wherever business was to be secured. In this way they hoped to provide the works with a sufficiency of orders of a general character which would, so to speak, ensure a fairly level loadline, and so avoid the periods of comparative inactivity which dependence on large contracts coming in at irregular intervals must involve.

A number of shareholders addressed the meeting respecting the position of the company, some touching upon its close relationship with the B.E.T. Co., and the amount of profit which was made on orders executed by the Brush Co. for the B.E.T. They asked for an assurance that such orders bore a reasonable amount of profit over cost price, and considered that Brush shareholders should be safeguarded against any other state of things. Mr. Tuckett held that the original shareholders of the Brush Co. had genuine ground for complaint, in that they were advised that the amalgamation of the Brush and B.E.T. Co.s was in the interests of the Brush shareholders as much as in the interests of the B.E.T. shareholders. He contended that the change of policy since had sent down the price of the shares.

The Chairman, in reply to these and other remarks, said that the Brush Co. did a considerable amount of business with the B.E.T. Co., but a large amount of business outside as well. The B.E.T. proportion was rather falling back lately. It varied from month to month, and he could assure them that the profit on the work done for the B.E.T. had been every bit as good, and in some cases better than they had got outside. Their total turnover for the year had been greater than in 1902, but the rate of profit was not so great. The recommendation to the Brush shareholders to exchange their shares for B.E.T. shares was made by the B.E.T. Co., not by the Brush directors. One of the principal reasons for the ordinary shares being so low was that no dividend had been paid on them for some years past. They could not go to par until a dividend was paid. If they passed the preference dividend, as some seemed to desire, shares of that class would also fall.

Mr. W. L. Madgen seconded the adoption of the report, and replied, repudiating certain reflections and insinuations cast by Mr. Tuckett upon the directors of the Brush and B.E.T. Cos. The Brush Co. now occupied the strongest position in the country in regard to those lines of goods which they had been supplying to the B.E.T. Co.—especially tramcars and trucks. He referred to the A.E.G. associated companies in Germany and the G.E. interests in America as giving those companies practical control of the electrical markets there. Through the association of the B.E.T. and Brush Companies, they could have friendly interests established throughout the United Kingdom. That association had been a great source of strength to the Brush Co.

The report was adopted.

A resolution was moved and seconded declaring the preference dividend, but an amendment was put before the meeting carrying that amount to reserve and passing the preference dividend. The amendment was lost (10 votes against and 6 in favour), and the original motion carried.

The retiring directors and auditors having been re-elected, the meeting closed with a vote of thanks to the chairman.

## Elmore's German and Austro-Hungarian Metal Co.

**The annual report for 1903 says that no material alteration has taken place in the figures in this company's accounts, except that the amount standing to the debit of profit and loss account has been increased by £3,080 13s. This amount includes £1,000, which was the balance of premium paid on the debenture stock, an item which will not appear again. The general charges for the year are considerably less than those of the previous year. The loan from the bankers is £4,000 more than on December 31st, 1902.**

The figures of the Metall Co. are not so satisfactory as could be desired. Trade in Germany during the year was slack, and in consequence a considerable amount of low-priced work had to be executed, with the result that the margin between the cost of copper and the selling price of the finished article showed a further decrease. The amount written off for depreciation and repairs and maintenance of plant, £2,710, is large, but the directors feel that it is to the advantage of the shareholders that this course should be taken. It has also been deemed advisable to write down the value of the finished and half-finished goods in stock at the end of the year, and this was responsible for a reduction of £2,700, so that the amount at which copper stands in the books of the company is considerably below its market value, thus safeguarding the company from any ill effect which might be caused by a sudden drop in the price of copper. There has been an expenditure of M. 158,650 (£7,932) during the year on new works, including the amount paid for the sole right to use the new machine in Germany. On the other hand, sundry creditors and bills payable are M. 26,839 (£1,341) less, and sundry debtors are M. 40,536 (£2,026) more, than in 1902. The new machine referred to in the report of the previous year is not yet completely erected, owing to the delay on the part of the makers in America, and on account of the delay on the part of the makers of transmission, &c., in Germany. The last deliveries have now been made, and the erection is almost finished. With regard to the plant and buildings, these have been maintained in a high state of efficiency, and considerable saving has been effected in the cost of production, and it is believed that a further decrease can be made. There is reason to believe that trade is improving, and likely to continue. The orders received for the first quarter of the present year show an increase of 40 per cent. compared with the same period of last year. Therefore, apart from any benefit which may accrue from the use of the new machine, the directors believe that there will be an increase in the profit earned.

Owing to the unfavourable financial condition of affairs in England, it is impossible for the directors to carry through the debenture stock conversion. The debenture-holders will therefore be asked to agree to a further postponement of three years. Patents have been granted in Austria and Germany for an improvement in the process, which the directors believe will prove to be of considerable value in the future. To sum up the financial position of the two companies, although we have spent £7,932 on new works, reduced sundry debtors and bills payable by £1,341, and increased the amount due from sundry debtors by £2,026, making a total of £11,299, this has been done without raising fresh capital, except an increase of the amount due to creditors on this side of £3,875, and had it not been for the depreciation of the copper stock and the £1,000 balance of premium on the debenture stock, the net result would have been a profit instead of a loss. Messrs. MacFarlan, Heal and Garnett have waived one-fourth of their fees for the past year.

## Brisbane Electric Tramways Investment Co.

**The report for 1903, to be submitted at the meeting on the 18th inst, states that dividends for 1903 on the shares held by this company amounted to £43,970, to which must be added sundry receipts £45, and amount brought forward from previous year £8,086, making a balance at credit of revenue account of £52,102.**

After deducting income-tax and general charges in London and expenditure in Brisbane, including the insurance undertaken by this company under its contract with the Tramways Co., £5,448, there remains a net balance available of £46,654. The directors recommend placing to reserve fund £5,000 and carrying forward £5,673. The result of the working of the tramways, as shown by the accounts of the original company for 1903, was:—Total receipts, £127,140, and total expenditure (including £1,258 for Queensland dividend duty and income-tax) £80,480, leaving net profit for the year £46,660, to which must be added the amount brought forward from 19.2, £3,062, leaving a balance of profit available of £49,722, which has been appropriated by the Tramways Co. in the following manner:—To credit of a fund for renewals (bringing it up to £6,000), £3,000, in payment of dividends on shares (including income-tax), £44,000, carrying forward to next account £2,722—£49,722.

## The Western Telegraph Co.

**The report of the directors for the half-year ended December 31st, 1903, says that the revenue for the period amounted to £222,020, and the working expenses to £93,140. After providing £13,579 for debenture stock and debenture interest and sinking fund, and £2,622 for income-tax, there remains a balance of £112,679; to this is added the sum of £2,640 brought forward from June 30th last, making a total of £115,319. First and second interim dividends, amounting to £62,379, have been paid, after transferring £30,000 to the general reserve fund, and £18 000 to the maintenance ships' reserve fund, there remains a balance of £4,939 14s. 5d., which is carried forward to the next account. The revenue includes £11,808 6s. 6d. dividends upon the company's investments in other telegraph companies, and £6,632 13s. 6d. interest on reserve fund investments.**

## The Globe Telegraph and Trust Co.

**The report for the year ended April 30th, 1904, shows that the net revenue for the year, after deduction of expenses, amounts to £203,010, and makes, with the balance of £3,071 10s. brought forward, a total of £206,082. From this amount there has been distributed the sum of £131,917 in interim dividends, leaving an available balance of £74,165. The directors recommend the payment of a final dividend of 3s. per share on the preference shares, and of 5s. per share on the ordinary shares, making, with previous distributions, total dividends for the year of 6 per cent., less income-tax, on the preference shares, and of 5½ per cent. net on the ordinary shares, leaving a balance of £3,057 10s. 9d. to be carried forward to the next account.**

## Callender's Cable and Construction Co.

**The report of the directors for 1903 shows a balance at the credit of profit and loss for the year's working of £52,647, which, with the balance brought forward from 1902, £24,480, makes £77,127. From this must be deducted: Interest on debenture stock, £9,000; dividend on preference shares, £10,000; appropriation for depreciation of plant and machinery, £11,480; for depreciation of office furniture, £191 = £30,671, leaving an available balance of £46,456. It is proposed to pay a dividend on the ordinary shares at the rate of 10 per cent. per annum (being 10s. per share) = £17,500; and a bonus of 2s. 6d. per share = £4,375; and to carry forward to next year's account £24,581 = £46,456.**

The out-turn from the factory was slightly in excess of that of the preceding year, but once again severe competition was experienced in all branches of the company's business, with the result that the prices obtainable were still further reduced, leaving but a small margin of profit. The company suffered severely from the unprecedented rainfall of 1903. The cost of carrying out street work and cable laying was considerably enhanced thereby. Heavy expenses were incurred at the factory at Erith from the same cause. These two items caused an abnormal expenditure amounting to many thousands of pounds, which, of course, has been met out of the year's profits. Owing to the general financial stringency, few new installations were undertaken, and in municipal work especially, orders for cable were considerably restricted for the same reason. In the last few weeks there is a distinct tendency towards better trade, and, although competition continues very keen, and prices are still low, there is some hope of better results during the present year's operations. Reference was made in last year's report to the various companies operating under Parliamentary powers for the supply of electricity over large areas, in some of which this company is closely interested. During the past year considerable progress has been made in this important branch of the electrical industry. There appears to be little doubt that, as soon as these companies are at work, great developments will take place in the use of electricity throughout Great Britain, and the directors are more convinced than ever that the policy which they have adopted with regard to these electric supply companies is the right one. During last summer circumstances arose with the Anchor Cable Co., Ltd., which, in the judgement of the board of that company, rendered it advisable that their business should be disposed of to one of the larger cable makers, and negotiations were entered into with this company. After carefully examining the property, and considering the possibilities of their factory at Leigh, the directors completed arrangements by which they acquired the whole of the shares of the Anchor Cable Co., Ltd. The original board retired; the direstorate of the Anchor Co. is now almost identical with that of this company, and its business is under this company's control. For various reasons it has been considered necessary not, as yet, to amalgamate the two concerns, but to run the Anchor Co. separately, and this course will be followed for the present. In addition to the purchase of those shares, this company has found the working capital which is necessary for the Anchor Co. The total amount of this investment and advance is shown in the balance-sheet. A special loan has been obtained from the company's bankers to enable this to be done; but, at an early date, it may be advisable to take the requisite steps for clearing this off. The directors are convinced that the acquisition of the Anchor Works has had most satisfactory results in many ways on the business of this company.

## West India and Panama Telegraph Co.

**The directors' report for the half-year ended December 31st, 1903, says that the amount to credit of revenue is £32,399 13s., against £31,062 17s. for the corresponding half-year of 1902. The expenses have been £25,243, against £20,679, leaving a balance of £7,156, to which is added £1,855 interest on investments, and £2,068 brought from last account, making a total of £11,080, with which it is proposed to deal as follows:—**

| | |
|---|---|
| Payment of 6s. per share on account of arrears of dividend to December 31st, 1903, on the first preference shares .. | £10,368 18 |
| Balance to current half-year's account .. .. .. .. | 710 15 |
| | £11,079 13 |

**The revenue account has been credited with the sum of £1,486, being a balance after the closing of the accounts attendant upon the loss of the ss. *Grappler*, and also with £1,500 accumulated after adjustment in respect of income-tax, but now no longer required.**

The directors regret to report that, without these transfers, the profits for the half-year would not have enabled them to recommend the payment of 6s. per share on account of arrears of dividend on the first preference shares. The expenses of repairing cables during the half-year amounted to £10,251 7s. 6d., being £2,576 10s. 2d. in excess of those for the corresponding period, attributable to a larger quantity of cable having been used in repairs. A further sum of £934 0s. 11d. has been charged to reserve for cable used in the partial renewal of the St. Lucia—St. Vincent section, which, it will be remembered, was interrupted by volcanic disturbances in May, 1902, and, after being repaired, was again interrupted by the same cause in the following September. After much difficulty, the repair of this section was successfully completed in February last.

## Auckland Electric Tramways Co.

**Mr. C. G. Tegetmeier presided at this company's meeting held at Donington House, W.C., on May 9th. In moving the adoption of the report (see Electrical Review, May 6th), he said that the results shown therein were gratifying, considering the early stage of the company. It was not until October that the whole system was in operation. The traffic receipts were £81,772, and they had carried 13,535,611 passengers, or nearly 200 times the population. On capital account they had spent £506,835, and they were now compelled to add to it by the addition of cars and extensions to the power plant, but this expenditure would conduce to economy in working, and to increased traffic receipts. They had temporarily borrowed from the bankers on their £85,100 of debenture stock, but were now disposing of the debentures, and would pay off the overdraft and satisfy other requirements. They had an accident on December 24th last, which caused three deaths and many injuries, but the subsequent inquiry showed that the accident was caused by the motorman losing his head. The working expenses, which included a very liberal expenditure on repairs and maintenance, amounted to 58 per cent. of the traffic receipts.**

**The report was adopted, and the retiring directors and auditors were re-elected.**

## Craigpark Electric Cable Co.

**Mr. James T. Tallis presided at the first annual general meeting of shareholders of this company, which was held in Glasgow on Monday.**

**In moving the adoption of the report, the Chairman said that the removal of the works from Craigpark to Springburn had caused considerable dislocation during some six months of the year. As the directors had expected, there was very little profit on the year's working, but in spite of the removal they were able to keep up the production. The establishment was now in perfect order. The golf ball section of the business had been *nil*. The directors received information that proceedings were to be taken by an American syndicate regarding a ball, the patent of which the Craigpark Co. considered belonged to them, and in the circumstances it was considered wise to cease manufacturing the ball in the meantime, pending the decision of the Courts. They had all the plant and they could re-start manufacturing whenever the way was again clear. He concluded by pointing out that even though the golfball section of the works was practically idle, the sales for the year were almost up to the value of those of the previous year.**

**Mr. W. R. Dick seconded, and the report was adopted.**

## Eastern Extension, Australasia and China Telegraph Co.

**The 61st half-yearly meeting of the above company was held at River Plate House, Finsbury Circus, on Wednesday last week.**

**In moving the adoption of the report, Sir J. Wolfe Barry, who presided, said the report was not altogether of a pleasant nature, but it might have been a great deal worse, considering the conditions under which they had had to work. The gross revenue for the half-year was £265,000, against £267,000 in the corresponding period of 1902. The revenue included £13,008 from interest on reserve fund and investments, and £9,460, the unappropriated balance of the reserve fund, for the removal of the head office. Had not these two items been brought into revenue, the decrease would have been about £25,000. The receipts from messages showed a net decrease of £20,850, which was a lower figure of diminution than estimated by the company, and under present conditions could not be considered altogether unsatisfactory. The decrease was spread over a large number of different traffics. Practically all the American traffic with Australia, China, Japan and the Philippines had been diverted to the Pacific and Government Pacific cables. A portion of the traffic between Australia and Great Britain had also been diverted to the Government Pacific line, but the actual loss by competition was less than had been anticipated. The reduction of traffic with China, Japan and the Philippines was the necessary outcome of the rates coming into operation in July, 1903, but increased traffic had lessened the loss. There had been an increased traffic with the Straits Settlements and Dutch Indies, and the company had also benefited by the rise in silver, and the quarterly revision in countries using silver coinage. The working and other expenses were £142,000, against £121,000 in the corresponding period; an increase of £20,000. About £11,000 of that was due to the increased staff at stations, principally in Australia and China; in the former case due to the competition of the bounty-fed British Pacific cable. They had also had a very heavy expenditure in connection with their two new repairing ships, although they hoped that the heavy expenditure of maintaining a vessel at Adelaide would be obviated in the future. The net profit for the year was £105,854, to which had to be added £71,036 brought forward, leaving £176,890 available for dividend. They recommended a final dividend of 2s. 6d., making 5 per cent. for the year, and a bonus of 4s. per share, making a total distribution for the year of 7 per cent., and carrying forward £41,890, as against £71,036 in the last half year. The capital account had been increased by the issue of £13,462 4 per cent. mortgage debenture stock, and the reserve fund had been debited with £10,845, the cost of further partial renewals to cables. The directors deemed it well that a representative of the board and the general manager should make a tour of inspection of the company's stations abroad and in the Colonies, and accordingly the Hon. George Peel and Mr. F. E. Hesse had been some months away, and had been brought into contact with Government and mercantile representatives, and had removed many wrong impressions with regard to the company's position. The hostilities between China and Japan and the closing of the landlines by the Russians had thrown a great strain on the company's staff in China, but the staff had worked well, and now that the Great Northern Telegraph Co. had obtained a connection with the Russian landlines, the strain would be relieved. No further action had been taken by the Federal Government with regard to the company having dealings direct with the telegraphing public in Melbourne and Brisbane, and pending a decision the company had its office in Melbourne. Proceeding, the chairman dealt with the competition of the Pacific cables, and said that, although the Government said there was no wish to compete with the Extension Co., yet, as a matter of fact, they had appointed canvassers, and had competed in many ways which he considered unfair. The result was that the cable system in Australasia was scarcely remunerative, and he did not anticipate much increase in the volume of traffic in the near future. The Pacific cable was not really required, and the result of laying it had been that the shareholders of their company had been unnecessarily injured and a heavy burden had been laid on the taxpayers of the mother country and the Colonies interested in the concern.**

**The Marquis of Tweeddale seconded the motion.**

**Replying to a question, the Chairman said he had nothing to add to what he said two years ago on the subject of wireless telegraphy. What he said then had proved to be correct.**

**The report was adopted.**

## Lymington Electric Light Co.

The annual general meeting was held at the supply station on April 29th, Mr. Keppel Poultney presiding. The directors' report stated that the progress made during the year had been satisfactory, the total connections having been increased from the equivalent of 6,124 to 8,211 8-c.p. lamps. The result of the year's trading, including a balance of £252 18s. 4d. brought forward, showed a profit to the credit of the net revenue account of £987, and, after paying interest on debentures and cash loan amounting to £522, there was a surplus of £465. A dividend at the rate of 4 per cent. for the year was recommended, which absorbed £324, and the balance of the Parliamentary expenses account (£55) having also been written off, there remained a balance of £86 8s. to be carried forward.

In moving the adoption of the report and statement of accounts, the Chairman said the year had been one of steady progress, which was attributable to the efficiency and energy of their secretary and manager. Their income had considerably increased, while their expenditure had appreciably decreased.

Mr. Wigham seconded, observing that Lymington was the smallest town in the British Islands with a permanent electric supply. [But is that correct; has not the speaker forgotten Ingleton, Fladbury, &c.?—Eds. E.R.]

## Official Announcements re Companies.

The following companies will be struck off the register within three months unless cause is shown to the contrary:—

American Roller Bearing Co., Ltd.
Colwyn Bay Electric Light and Power Co., Ltd.
Electrical Maintenance and Accessories Syndicate, Ltd.
Electrical Navigation Protection Co., Ltd.
Fermoy and District Electricity Co., Ltd.
Fleet and District Electricity Co., Ltd.
Italian Electrical Light and Power Co., Ltd.
Leeds, Wakefield, Dewsbury and District Electric Tramways, Ltd.
Oppermann-Fischer Patents Proprietary, Ltd.
Pollard Electrical Engineering Co., Ltd.
Tramway Trolley Co., Ltd.

**County of London Electric Supply Co.**—The amount of electricity sold in the London districts during the quarter ended March 31st last, is estimated to realise about £37,925, which compares with £32,077 for the corresponding period of last year.

**Castner-Kellner Alkali Co.**—The report for the year ended March 31st last, states that the net profit for the year, after deducting the usual expenditure for maintenance of works, plant and machinery, is £42,021. To this has to be added the amount brought forward from last account, £13,152, together £55,173. Deducting debenture interest £10,376, there remains an available balance of £44,797. The directors recommend that £15,000 be appropriated to depreciation reserve, increasing that account to £70,000; that a dividend of 4 per cent. be paid for the year, leaving £11,797 to be carried forward.

**Marconi's Wireless Telegraph Co.**—A financial daily says that the directors announce that in accordance with a circular sent to shareholders, they have conditionally allotted to the shareholders in proportion to their holdings 25,000 shares of £1 each, at the rate of one new share for every eight shares held on 3rd inst., at the price of £1 5s. per share. No fractions of shares will be issued, and consequently holders of less than eight shares will not be entitled to participate in the *pro rata* allotment, and shareholders holding upwards of eight shares will only be entitled to one new share for each complete eight shares held.

**Stock Exchange Notices.**—The Committee has appointed special settling days as under:—Wednesday, May 18th: Charing Cross and Strand Electricity Supply Corporation, Ltd.—Further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 70,001 to 80,000. Thursday, May 26th: Charing Cross and Strand Electricity Supply Corporation, Ltd.—Further issue of 10,000 4½ per cent. cumulative preference shares of £5 each, fully paid, Nos. 70,001 to 80,000; and has ordered same to be quoted in the Official List.

**Blackheath and Greenwich District Electric Light Co.**—The adjourned meeting of the debenture stock-holders was held at Winchester House last Friday, when the modifications of their rights under the trust deed were duly approved.

**Market Drayton Electric Light and Power Co.**—The annual meeting was held on Saturday, Mr. R. C. Donaldson-Hudson presiding. The report, which was adopted, showed that the company, although only formed during 18 months ago, had made very satisfactory progress. The year's workings to December 31st, 1903, produced a net profit of £396, which, with the previous balance of £82, gave a total of £478. Out of this it was decided to write off £40 from the preliminary expenses, to carry £360 to a reserve for renewal fund account, and the balance of £78 to take to the next account. During the year the number of connections had been increased from an equivalent of 1,981 to 4,759 8-c.p. lamps.

**Urban Electric Supply Co.**—Letters of allotment for the issue of £200,000 4½ per cent. first mortgage debenture stock were posted last week.

**Willans & Robinson, Ltd.**—The poll regarding the proposal to elect Mr. J. C. Peache on to the board at £2,000 per annum and a share of the profits, took place on Wednesday, and the proposition was carried by an overwhelming majority, there being only about 100 votes against it, and something like 70,000 in favour.

## STOCKS AND SHARES.

Wednesday Evening.

To some extent Stock Exchange business has fallen off in most of the markets. While there are few signs of relapse in prices, the amount of trade is less, both as regards investment and speculation The possible attitude of Paris in the event of the Russian losses becoming yet more serious, puts a damper upon gambling in Kaffir shares, while the rise in the best class of stocks has already been sharp enough to make the calling of a halt quite natural, especially as there are plenty of new issues in the air, which may take a fair proportion of the money available for investment. Our price lists this week continue to show an improvement in Telegraphs, a few small rises in Electricity Supply stocks, and a better tone amongst Traction varieties.

Partly on the coming electrification of the line, and partly upon shop support, Districts have shot up some 6 points this week, and the 4 per cent. Debenture stock, of which we wrote last time, is 1 up at 104 middle. Metropolitan is also about 4 better at 97, and the loud complaints that are being raised as to the undercrowding on the Undergrounds certainly answer a useful purpose to stockholders in directing attention to the popularity of the lines, even under the existing conditions of discomfort. City and South London Ordinary has risen to 51, although, as a matter of fact, the market has been a buyer at 50 for weeks past. Central Londons are steady, while Waterloo and City maintains its slight advance. The steam stocks are remarkably good, in sympathy with the advance in Consols.

Rises of ¼ each have taken British Electric Traction Ordinary to 9¼, and the Preference to 10¼, the Debenture stock being better, too, at 116½. London United Tramways Preference are 11½, and the Debenture stock 102, business having been done at both those prices during the last day or two. Anglo-Argentine Preference are 5, and City of Buenos Ayres 9⅛. Buenos Ayres and Belgrano "A" Preference at 5½ and the "B" Preference at 5 are inclined to be a little harder. Auckland Electric Trams 5 per cent. Debenture changed hands at 99½, the report, which we have already summarised, being considered a very good one. British Columbia Electric Railway stocks have barely changed.

Seven rises go against two declines in the Electricity Supply section, and of the former four are amongst the Debenture stocks. Central Electric 4 per cent. Debenture and Chelsea Debenture are both a point up at 108½. Metropolitan 3½ per cent. Debenture has risen 2 to 98½, and the company's Preference shares are ⅛ higher at 5⅝—the same shares for which it was difficult to find buyers at 1s. premium when they were issued at £5 not long ago. The Ordinary shares remain steady at 19½, unchanged at the new order of things that is to arise in Marylebone. Edmundson's Preference fell a fraction to 5⅝, and Urban Preference at 4⅜ are ⅛ easier. The new Urban Debenture stock can be bought at par. South Londons improved another 5s. to 4 upon continuance of last week's buying on the quarterly statement. City of London Ordinary at 10⅜ are ¼ harder; Charing Cross shares have not moved, although ocular demonstration of the company's vitality has been inconveniently palpable in the torn-up road outside the Stock Exchange in Throgmorton Street.

Commercial Cable certificates, in falling 5, have got back to 180, but Anglo-American Preferred is being picked up as a speculative investment, and at 95 is a point better. The Eastern group forges steadily ahead. Eastern Ordinary stands 2 higher at 127½, with the Preference and Debenture stocks both harder. Eastern Extension Debenture has stiffened to 105½, but Globe Ordinary are ¼ down at 9½, and the Preference a similar sum to 12½. Western Telegraph shares have put on 5s. at 12⅜, and the Debenture stock a point at 101½. This department is receiving increased consideration from those who are willing to accept some slight risk in exchange for a good rate of interest on their money. Great Northern are 10s. duller at 25½.

In the National Telephone list the first and second Preference shares have improved to 11, a rise of £1. The new debenture stock is officially quoted now, and is called 29 to 30, this being for the scrip with 70 per cent. to be paid. On the fully-paid stock the premium is 4½ per cent. United River Plate Telephones and Orientals have not altered.

No change occurred in any of the Brush Electrical issues after Tuesday's optimistic meeting, but Electric Construction Ordinary have moved down ⅛ to 1½. British Insulated and Helsby Cables Debenture has risen 1; beyond these, the fluctuations in Miscellaneous shares are very few. Westinghouse Debenture is 91½, and the Preference shares 4. British Thomson-Houston 4½ per cent. Debenture continues at 102. Babcock Ordinary are still 2⅞, and the Preference 1⅛, while the Willans & Robinsons are 2½, and 3½ for the like shares respectively.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1901. | 1902. | 1903. | Closing Quotations May 4th. | Closing Quotations May 11th. | Business done week ended May 11th, 1904. Highest | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 67,100 | African Direct Telegraph, 4 % Debs. | 100 | .. | .. | .. | 99 —102 | 98 —102 | 100 | 99 |
| 25,000 | Amazon Telegraph Co.'s shares, Nos. 1 to 25,000 | 10 | .. | .. | .. | 2½— 3½ | 2½— 3½ | .. | .. |
| 119,700£ | Do. do. 5 % Debs., Nos. 1 to 1,250 Red. | 100 | .. | .. | .. | .. — .. | 70 — 80 | .. | .. |
| 788,840 | Anglo-American Telegraph | Stock | 61s. | 60/6 | 61s. | 49 — 52 | 49 — 52 | .. | .. |
| 3,105,580 | Do. do. do. 6 % Pref. | Stock | 6 % | 6 % | 6 % | 93 — 95 | 94 — 96 | 95½ | 94 |
| 3,105,580 | Do. do. do. Deferred | Stock | 2s. | 1/- | 2s. | 7½— 7¾ | 7½— 7¾ | 7⅝ | .. |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 5 % | 6 % | .. | 4¾— 5¼ | 4¾— 5¼ | .. | .. |
| 13,333,300$ | Commercial Cable | $100 | 8 % | 8 % | .. | 180 —190 | 175 —185 | .. | .. |
| 1,841,209 | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | .. | .. | .. | 93 — 95 | 93 — 95 | 95 | 94½ |
| 16,000 | Cuba Telegraph | 10 | 4 % | 6¼% | 5 % | 7½— 8½ | 7½— 8½ | 8⅛ | 7⅞ |
| 6,000 | Do. 10 % Pref. | 10 | .. | .. | .. | 15½— 16½ | 15½— 16½ | 15½ | .. |
| 12,981 | Direct Spanish Telegraph | .. | .. | .. | .. | .. — .. | .. — .. | .. | .. |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | .. | .. | .. | 7 — 8 | 7 — 8 | .. | .. |
| 80,000 | Do. do. 4½ % Debs. | 50 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 60,710£ | Direct United States Cable | 20 | 3½% | 3½% | .. | 10 — 10½ | 10 — 10½ | .. | .. |
| 85,800 | Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 7 % | 7 % | .. | 123 —128 | 125 —130 | 129 | 126 |
| 1,955,565 | Do. 8½ % Pref. Stock | 100 | .. | .. | .. | 85 — 88 | 86 — 89 | 88⅜ | 86⅜ |
| 1,534,645 | Do. 4 % Mort. Deb. Stock Red. | Stock | .. | .. | .. | 103 —106 xd | 104 —107 | 105¼ | 105 |
| 800,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 12 — 12½ | 12 — 12½ | 12⅛ | 12⅛ |
| 320,000£ | Do. 4 % Deb. Stock | Stock | .. | .. | .. | 103 —106 | 104 —107 | .. | .. |
| 800,000 | Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909 | 100 | .. | .. | .. | 99 —102 | 99 —102 | 100½ | .. |
| 200,000£ | Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | .. | .. | .. | 99 —101 xd | 99 —102 | .. | .. |
| 180,227 | Globe Telegraph and Trust | 10 | 5½% | £3 16 7* | 5½% | 9¼— 9¾ | 9 — 9½ | 9⅜ | 9 |
| 180,045 | Do. do. 6 % Pref. | 10 | .. | .. | .. | 12⅝— 13 | 12⅝— 13⅛ | 13⅛ | 12⅝ |
| 150,000 | Great Northern Telegraph, of Copenhagen | 10 | 15 % | 12½% | 15 % | 26 — 27 | 25 — 26 | .. | .. |
| 58,700 | Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | .. | .. | .. | 98 —101 | 98 —101 | .. | .. |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10% | 10 % | 40 — 43 | 40 — 43 | .. | .. |
| 100,000£ | London Platino-Brasilian Telegraph, 6 % Debs. | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |
| 1,988,333 | National Telephone, Pref. Stock | 100 | 5 % | 6 % | 6 % | 103 —105 | 103 —105 | 104½ | 103⅜ |
| 1,966,667 | Do. do. Def. Stock | 100 | .. | 4½% | 5 % | 88 — 91 | 88 — 91 | 89 | 88 |
| 15,000 | Do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 10 — 12 | 11 — 13 | 11⅞ | .. |
| 15,000 | Do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 10 — 12 | 11 — 13 | .. | .. |
| 2,250,000 | Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5 — 5½ | 5 — 5½ | .. | .. |
| 000,000£ | Do. do. 3½ % Deb. Stock Red. | Stock | 3½% | 3½% | 3½% | 97 — 99 | 97 — 99 | .. | .. |
| 689,593 | Do. do. 4 % Deb. Stock Red. | 100 | 4 % | 4 % | 4 % | 102 —104 | 102 —104 | 103½ | 103¼ |
| 1,000,000 | Do. do. Prov. Certs., 70 % to be paid | .. | .. | .. | .. | 28 — 30 | .. — .. | 29⅛ | .. |
| 179,313 | Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid | 1 | 6 % | 6 % | 6½% | ⅛— 1/16 xd | ⅛— 1/16 | ⅛ | .. |
| 50,000 | Do. do. do. 6 % Cum. Pref. | 1 | .. | .. | .. | 1/16— 1/8 xd | 1/16— 1/8 | .. | .. |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 11,899 | Reuter's | 8 | 5 % | .. | .. | 6¾— 7⅛ | 6¾— 7⅛ | 7¼ | .. |
| 3,803 | Submarine Cables Trust | Cert. | .. | .. | .. | 117 —122 | 117 —122 | 118 | .. |
| 58,000 | United River Plate Telephone | 5 | 7 % | 7 % | .. | 5¾— 6 | 5¾— 6 | .. | .. |
| 40,000 | Do. do. 5 % Cum. Pref., Nos. 1 to 40,000 | 5 | .. | .. | .. | 4¾— 5¼ | 4¾— 5¼ | 5 | .. |
| 172,947£ | Do. do. 5 % Debs. | Stock | .. | .. | .. | 103 —106 | 103 —106 | .. | .. |
| 15,609 | West African Telegraph, Shares | 10 | .. | 2 % | .. | 5 — 6 | 5 — 6 | .. | .. |
| 150,000£ | West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel. | 100 | .. | .. | .. | 97 —100 | 97 — 100 | .. | .. |
| 267,930 | Western Telegraph, Ltd., Nos. 1 to 267,930 | 10 | 7 % | 7 % | 7 % | 12½— 12¾ | 12½— 13 | 13 | 12⅞ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 400,000 | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 99 —102 | 100 —103 | 102 | 101½ |
| 88,821 | West India and Panama Telegraph | 10 | .. | .. | .. | ⅜— ½ | ⅜— ½ | .. | .. |
| 84,568 | Do. do. do. 6 % Cum. 1st Pref. | 10 | .. | .. | .. | 5¾— 6¼ | 5¾— 6¼ | 6¼ | 6 |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | .. | .. | .. | 4½— 5¼ | 4½— 5¼ | .. | .. |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,600 | 100 | .. | .. | .. | 100 —103 | 100 —103 | .. | .. |

## ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | British Aluminium 7 % Cum. Pref. | 10 | .. | .. | .. | 4½— 5½ | 4½— 5 | .. | .. |
| 800,000£ | Do. do. 5% 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 87 — 93 xd | 87 — 93 | .. | .. |
| 100,000 | British Electric Traction | 10 | 9 % | 8 % | .. | 8½— 9 | 9 — 9½ | 9⅜ | 8⅞ |
| 100,000 | Do. do. 6 % Cum. Pref. | 10 | .. | .. | .. | 9⅜— 10⅛ | 10 — 10⅜ | 10⅛ | 9⅝ |
| 600,000£ | Do. do. 5 % Perpetual Debenture Stock | Stock | .. | .. | .. | 114 —117 | 115 —118 | 117 | 116½ |
| 100,000 | British Insulated and Helsby Cables | 5 | 10 % | 10 % | 8 % | 5½— 5⅝ | 5½— 5⅝ | .. | .. |
| 100,000 | Do. do. 6 % Cum. Pref. | 5 | .. | .. | .. | 5¾— 5¾ | 5¾— 5¾ | .. | .. |
| 50,000 | Do. do. 4½ % 1st Mort. Deb. Red. | 100 | .. | .. | .. | 101 —106 | 102 —105 | .. | .. |
| 50,000 | ¶Browett, Lindley & Co., Ord. | £1 | Nil | .. | .. | ⅞— 1⅛ | ⅞— 1⅛ | .. | .. |
| 50,000 | ¶ Do. do. 6 % Cum. Pref. | £1 | 6 % | .. | .. | 14/6 to 15/6 | 14/6 to 15/6 | .. | .. |
| 105,731 | Brush Electrical Engineering, Ord., 1 to 105,731 | 2 | Nil | Nil | Nil | ½— 1 | ½— 1 | .. | .. |
| 150,000 | Do. do. Non-cum. 6 % Pref. | 2 | 3 % | 6 % | 6 % | 1 — 1½ | 1 — 1½ | 1¼ | .. |
| 125,000£ | Do. do. 4½ % Perp. Deb. Stock | Stock | .. | .. | .. | 96 — 99 | 96 — 99 | .. | .. |
| 125,000£ | Do. do. 4½ % Perp. 2nd Deb. Stock | Stock | .. | .. | .. | 73 — 78 | 73 — 78 | .. | .. |
| 85,000 | Callender's Cable Construction shares | 5 | 20 % | 15 % | 12½% | 10½— 11½ | 10½— 11½ | .. | .. |
| 40,000 | Do. do. do. 5 % Cum. Pref. | 5 | .. | .. | .. | 5½— 5¾ | 5½— 5¾ | .. | .. |
| 90,000£ | Do. do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | .. | .. | .. | 104 —108 | 104 —108 | .. | .. |
| 1,860,014 | Central London Railway, Ord. Stock | Stock | 4 % | 4 % | 4 % | 92 — 95 | 92 — 95 | 94½ | 92½ |
| 494,998 | Do. do. 4 % Pref. Stock | Stock | 4 % | 4 % | 4 % | 98 —101 | 98 —101 | .. | .. |
| 494,998 | Do. do. Def. do. | Stock | 4 % | 4 % | 4 % | 85 — 88 | 85 — 88 | .. | .. |
| 1,330,000 | City and South London Railway | Stock | 2 % | 3½% | 2¾% | 49 — 52 | 50 — 52 | 52 | 50½ |
| 85,000 | Crompton & Co., Nos. 1 to 85,000 | 5 | 7½% | 6 % | .. | 1⅞— 2⅛ | 1⅞— 2⅛ | .. | .. |
| 100,000£ | Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red. | .. | .. | .. | .. | 96 — 99 | 96 — 99 | 97 | .. |
| 99,261 | Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261 | 5 | Nil | Nil | .. | 0 — ⅛ | 0 — ⅛ | .. | .. |
| 17,189 | Do. do. "A" shares, 01—017,189 | 5 | Nil | Nil | .. | ⅛— 1/4 | ⅛— 1/4 | .. | .. |
| 44,923£ | Do. do. 4 % Deb. Stock Red. | 100 | .. | .. | .. | 72 — 77 | 72 — 77 | .. | .. |
| 100,000£ | Do. do. 5% 2n Deb. Stock Prov. Certs. all pd. | 100 | .. | .. | .. | 74 — 79 | 74 — 79 | .. | .. |
| 112,100 | Electric Construction, 1 to 112,100 | 2 | 6 % | 6 % | .. | 1⅛— 1⅜ | 1⅛— 1⅜ | 1⅛ | .. |
| 31,390 | Do. do. 7 % Cum. Pref., 1 to 31,390 | 2 | .. | .. | .. | 2⅛— 2 | 2⅛— 2 | .. | .. |
| 85,500£ | Do. do. 4 % Perp. 1st Mort. Deb. Stock | Stock | .. | .. | .. | 97 —100 | 97 —100 | .. | .. |
| 25,000 | General Electric Co. (1900), 5 % Cum. Pref. | 10 | 5 % | 5 % | .. | 9¼— 9⅜ | 9¼— 9⅜ | .. | .. |
| 200,000 | Do. do. 4 % Mort. Deb. | Stock | .. | .. | .. | 98 — 98 | 98 — 98 | .. | .. |
| 200,000 | Henley's (W. T.) Telegraph Works, Ord. | 5 | 20 % | 20 % | 15 % | 11⅛— 12⅛ | 11⅛— 12⅛ | .. | .. |
| 200,000 | Do. do. 4½ % Pref. | 5 | .. | .. | .. | 5 — 5⅛ | 5 — 5⅛ | .. | .. |
| 45,300 | Do. do. 4½ Mort. Deb. Stock | Stock | .. | .. | .. | 107 —111 | 107 —111 | .. | .. |
| 50,000 | India-Rubber, Gutta-Percha & Telegraph Works | 10 | 10 % | 10 % | .. | 18⅛— 19⅛ | 18⅛— 19⅛ | 19 5/16 | 18⅞ |
| 800,000£ | Do. do. do. 4 % 1st Mort. Deb. | 100 | .. | .. | .. | 99 —102 | 99 —102 | .. | .. |
| 37,500 | †Liverpool Overhead Railway, Ord. | 10 | 1½% | 1½% | .. | 4¼— 4½ | 4¼— 4½ | .. | .. |
| 10,000 | † Do. do. Pref. £10 paid | 10 | .. | .. | .. | 10 — 10⅜ | 10 — 10⅜ | .. | .. |
| 37,350 | Telegraph Construction and Maintenance | 12 | 20 % | 20 % | 20 % | 34 — 37 | 34 — 37 | 37 | 35⅞ |
| 150,000£ | Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909 | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 640,000£ | Waterloo & City Railway, Ord. Stock | 100 | 3 % | 3½% | 3½% | 90 — 93 | 90 — 93 | .. | .. |

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st, 1904).

## SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

| Present Issue. | NAME. | Stock or Share. | Dividends for the last three years | | | Closing Quotations May 4th. | Closing Quotations May 11th. | Business done week ended May 11th, 1904. | |
|---|---|---|---|---|---|---|---|---|---|
| | | ‡ | 1901. | 1902. | 1903. | | | Highest. | Lowest |
| 100,000 | Blackheath and Greenwich Dist. Electric Light, Ord... .. .. | 1 | .. | .. | .. | ⅜ — ⅞ | ⅜ — ⅞ | .. | .. |
| 50,000 | Do. 7 % Pref. .. .. .. .. | 1 | .. | .. | .. | 1 — 1¼ | 1 — 1¼ | 1⅜ | .. |
| 100,000 | Do. 4½% 1st Deb. Stock, Prov. Certs. | 100 | .. | .. | .. | 115 —120 | 117 —122 | .. | .. |
| 20,000 | Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 .. | 5 | 8 % | 8 % | 10 % | 10¾ — 11¼ | 10¾ — 11¼ | .. | .. |
| 20,000 | Do. do. 7 % Cum. Pref. .. | 5 | .. | .. | .. | 10¼ — 10¾ | 10¼ — 10¾ | .. | .. |
| 250,000 | Central Electric Supply 4 % Guar. Deb. Stock .. .. .. .. | 100 | .. | .. | .. | 106 —109 | 107 —110 | .. | .. |
| 50,000 | Charing Cross and Strand Electricity Supply .. .. .. .. | 5 | 10 % | 10 % | 8 % | 7¼ — 7⅜ | 7⅜ — 7⅝ | 7⅝ | 7 5/16 |
| 70,000 | Do. do. do. 4½% Cum. Pref. | 5 | .. | .. | .. | 5⅛ — 5⅜ | 5⅜ — 5⅝ | 5 7/16 | 5⅜ |
| 40,000 | Do. do. "City Undertaking" 4½% Cum. Pref. | 5 | .. | .. | .. | 4¾ — 5 | 4¾ — 5 | .. | .. |
| 40,000 | Do. do. 1903 .. .. .. .. | 5 | .. | .. | .. | 4¾ — 5 | 4¾ — 5 | 4 15/16 | .. |
| 250,000 | Do. do. 4 % Deb. Stock Red. .. .. .. .. | 100 | .. | .. | .. | 102 —104 | 102 —104 | .. | .. |
| 44,486 | *Chelsea Electricity Supply, Ord. .. .. .. .. .. | 5 | 4 % | 4½% | 5¼% | 6⅛ — 6⅜ | 6⅛ — 6⅜ | 6¼ | 6¼ |
| 150,000‡ | Do. do. % Deb. Stock Red. .. .. .. .. | Stock | .. | .. | .. | 106 —109 | 107 —110 | .. | .. |
| 70,595 | City of London Electric Lighting, Ord. 40,001—110,595 .. | 10 | 5 % | 5 % | 5 % | 10¼ — 10½ | 10¼ — 11 | 10⅞ | 10½ |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 .. .. .. .. | 10 | .. | .. | .. | 13 — 14 | 13 — 14 | 13⅜ | .. |
| 400,000‡ | Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid .. .. | .. | .. | .. | .. | 121 —126 | 121 —126 | .. | .. |
| 800,000 | Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid .. .. | 100 | .. | .. | .. | 101 —104 | 101 —104 | .. | .. |
| 40,000 | County of London & Brush Prov. Electric Lighting, Ord. 1—40,000.. | 10 | 4 % | 4 % | 4 % | 7 — 8 | 7 — 8 | .. | .. |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000.. | 10 | .. | .. | .. | 11 — 12 | 11 — 12 | .. | .. |
| 400,000‡ | Do. do. 4½% Deb. Stock .. .. .. .. | .. | .. | .. | .. | 106 —109 | 106 —109 | .. | .. |
| 250,000 | Do. do. 4½% 2nd Deb. Stock .. .. .. .. | Stock | .. | .. | .. | 99 —102 xd | 99 —102 | 100¼ | 100⅛ |
| 50,000 | Edmundson's Electric Corporation, Ord. Shares .. .. .. | 5 | 7 % | 7 % | .. | 5⅜ — 6⅛ | 5⅝ — 6⅛ | 6 | 5⅞ |
| 30,000 | Do. do. 6 % Cum. Pref. .. .. .. | .. | .. | .. | .. | 5⅜ — 6⅛ | 5⅝ — 5⅞ | 5 13/16 | .. |
| 140,000 | Do. do. 4½% 1st Mort. Deb. Stock .. | 100 | .. | .. | .. | 104 —107 xd | 104 —107 | .. | .. |
| 21,000 | Kensington and Knightsbridge Electric Ord. .. .. .. .. | 5 | 10 % | 10 % | 12½ | 11½ — 12½ | 11½ — 12¼ | 11⅝ | .. |
| 90,000 | Do. do. do. 4 % Debenture Stock .. | Stock | .. | .. | .. | 102 —105 | 102 —105 | 103½ | .. |
| 110,000 | London Electric Supply Corporation, Limited, Ord. .. .. .. | 3 | .. | .. | .. | 1¼ — 1⅜ | 1¼ — 1⅜ | .. | .. |
| 49,840 | Do. do. do. 6 % Pref. .. .. .. | 5 | .. | .. | .. | 4¾ — 5 | 4¾ — 5 | .. | .. |
| 250,000‡ | Do. do. do. 4 % 1st Mort. Deb. Stock Red | Stock | .. | .. | .. | 95 — 98 | 95 — 98 | .. | .. |
| 100,000 | Metropolitan Electric Supply, 1 to 100,000 .. .. .. .. .. | 10 | 6¾% | 7½% | 8⅜% | 19 — 20 | 19 — 20 | 19⅝ | 19⅜ |
| 71,106 | Do. do. 4½% Cum. Pref. 1—71,106, £3 paid .. | 5 | .. | .. | .. | 5⅜ — 5⅝ | 5⅜ — 5½ | 5⅝ | 5 7/16 |
| 220,000‡ | Do. do. 4½% 1st Mort. Deb. Stock .. .. | .. | .. | .. | .. | 109 —113 | 109 —113 | .. | .. |
| 250,000‡ | Do. do. 3½% Mort. Deb. Stock Red .. .. | Stock | .. | .. | .. | 95 — 98 | 97 —100 | .. | .. |
| 10,852 | Notting Hill Electric Lighting .. .. .. .. .. | 10 | 6 % | 6 % | 6 % | 12¾ — 13½ | 12¾ — 13½ | 12 9/16 | .. |
| 40,000 | St. James' and Pall Mall Electric Light, Ord. .. .. .. .. | 5 | 14½% | 14½% | 14½% | 14 — 15 | 14 — 15 | 14 13/16 | .. |
| 20,000 | Do. do. do. 7 % Pref. 20,081 to 40,080 | 5 | .. | .. | .. | 8 — 9 | 8 — 9 | 8 13/16 | 8¼ |
| 150,000‡ | Do. do. do. 3½% Deb. Stock Red .. | 100 | .. | .. | .. | 97 —100 | 97 —100 | 97½ | .. |
| 12,000 | Smithfield Markets Electric Supply, Ord. .. .. .. .. | 5 | .. | 2½% | 4 % | 3 — 3½ | 3 — 3½ | .. | .. |
| 50,000 | Do. do. do. 4 % Deb. Stock .. .. | Stock | .. | .. | .. | 85 — 90 | 85 — 90 | .. | .. |
| 65,000 | South London Electricity Supply, Ord. .. .. .. .. .. | 5 | .. | 1⅜% | 3 % | 3¾ — 4 | 3¾ — 3⅞ | 3 13/16 | 3¾ |
| 30,000 | Urban Electric Supply, Ord. .. .. .. .. .. | 5 | .. | .. | .. | 4⅛ — 4¼ | 4⅛ — 4¼ | .. | .. |
| 30,000 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | .. | .. | .. | 4⅛ — 5 | 4⅛ — 4¼ | .. | .. |
| 110,000 | Westminster Electric Supply, Ord. .. .. .. .. .. | 5 | 10½% | 12 % | 13½% | 12⅛ — 13⅛ | 12⅛ — 13⅛ | 12 1/16 | 12⅛ |
| 28,141 | Do. do. 5 % Cum. Pref. .. .. .. .. | 5 | .. | .. | .. | 6¼ — 6⅝ | 6¼ — 6⅝ | 6¼ | .. |

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

## MARKET QUOTATIONS, Wednesday, May 11th.

| | CHEMICALS, &c. | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|---|
| a | Acid, Hydrochloric .. .. .. | per cwt. | 5/- | .. |
| a | ,, Nitric .. .. .. .. | per cwt. | 22/- | .. |
| a | ,, Oxalic .. .. .. .. | per cwt. | 32/- | .. |
| a | ,, Sulphuric .. .. .. | per cwt. | 5/6 | .. |
| a | Ammoniac, Sal .. .. .. | per cwt. | 42/- | .. |
| a | Ammonia, Muriate (crystal) .. | per ton | £33 10 | .. |
| a | ,, ,, .. .. .. | per ton | £30 | .. |
| a | Bleaching powder .. .. .. | per ton | £4 10 | .. |
| a | Bisulphide of Carbon .. .. | per ton | £15 | .. |
| a | Borax .. .. .. .. .. | per ton | £13 | .. |
| a | Benzole (90 %) .. .. .. | per gal. | 7/- | .. |
| a | ,, (50/90 %) .. .. .. | per gal. | 5/6 | .. |
| a | Copper Sulphate .. .. .. | per ton | £21 10 | .. |
| a | Lead, Nitrate .. .. .. | per ton | £24 | .. |
| a | ,, White Sugar .. .. .. | per ton | £31 | .. |
| a | ,, Peroxide .. .. .. | per ton | £27 10 | .. |
| a | Methylated Spirit .. .. .. | per gal. | 2/6 | .. |
| a | Naphtha, Solvent (90% a 160° C). | per gal. | 5/6 | .. |
| a | Potash, Bichromate, in casks .. | per lb. | 3d. | .. |
| a | ,, Caustic (75/80%).. .. | per ton | £24 | .. |
| a | ,, Bisulphate .. .. .. | per ton | £35 | .. |
| a | Shellac .. .. .. .. | per cwt. | 225/- | .. |
| a | Sulphate of Magnesia .. .. | per ton | £4 10 | .. |
| a | Sulphur, Sublimed Flowers .. | per ton | £6 10 | .. |
| a | Recovered .. .. | per ton | £5 10 | .. |
| a | ,, Lump .. .. .. | per ton | £5 | .. |
| a | Soda, Caustic (white 70 %) .. | per ton | £10 15 | .. |
| a | Crystals .. .. .. | per ton | £3 | .. |
| a | Bichromate, casks.. .. | per lb. | 2½d. | .. |
| | **METALS, &c.** | | | |
| b | Aluminium Ingots, in ton lots .. | per ton | £130 | .. |
| b | ,, Wire, in ton lots .. | per ton | £168 | .. |
| b | ,, Sheet, in ton lots .. | per ton | £166 | .. |
| p | Babbitt's metal ingots .. .. | per ton | £43 to £130 | .. |
| c | Brass (rolled metal 2" to 12") basis | per lb. | 6⅝d. | .. |
| c | ,, Tube (brazed) .. .. | per lb. | 8⅞d. | .. |
| c | ,, ,, (solid drawn).. .. | per lb. | 7⅞d. | .. |
| c | ,, Wire, basis.. .. .. | per lb. | 7d. | .. |
| c | Copper Tubes (brazed) .. .. | per lb. | 9¼d. | .. |
| c | ,, ,, (solid drawn) .. | per lb. | 9⅝d. | .. |
| g | Copper Bars (best selected .. | per ton | £74 | .. |

| | METALS, &c. (*continued*). | | Latest Price. | Week's Inc. or Dec. |
|---|---|---|---|---|
| g | Copper Sheet .. .. .. .. | per ton | £74 | .. |
| g | ,, Rod .. .. .. .. | per ton | £74 | .. |
| e | ,, (Electrolytic) Bars .. | per ton | £64 | .. |
| e | ,, ,, Sheets .. | per ton | £80 | .. |
| e | ,, ,, Rod .. .. | per ton | £74 | .. |
| e | ,, ,, H.C. Wire | per lb. | 8d. | .. |
| f | Ebonite Rod .. .. .. | per lb. | 3/3 | .. |
| f | ,, Sheet .. .. .. | per lb. | 3/- | .. |
| n | German Silver Wire .. .. | per lb. | 1/6 | .. |
| h | Gutta-percha fine .. .. .. | per lb. | 3/- | .. |
| h | India-rubber, Para fine .. .. | per lb. | 4/8 to 4/9 | .. |
| i | Iron, Charcoal Sheets .. .. | per ton | £18 | .. |
| i | ,, Pig (Cleveland warrants) | per ton | 44/6 | .. |
| i | ,, Forgings, according to size | per ton | From £11 | .. |
| i | ,, Scrap, heavy .. .. | per ton | 47/6 to 50/- | .. |
| i | ,, Wire, galvanised No. 8 .. | per ton | £9 15 | .. |
| g | Lead, English Ingot .. .. | per ton | £12 2 6 to £12 5 | 2/6 to 5/- dec. |
| g | ,, ,, Sheet .. .. | per ton | £13 | .. |
| m | Manganin Wire No. 28 .. .. | per lb. | 8/- | .. |
| g | Mercury .. .. .. .. | per bot. | £8 2 6 | .. |
| d | Mica (in original cases) small .. | per lb. | 6d. to 1/ | .. |
| d | ,, ,, ,, medium | per lb. | 2/6 to 4/- | .. |
| d | ,, ,, ,, large .. | per lb. | 4/6 to 8/6 | .. |
| p | Phosphor Bronze, plain castings | per lb. | 1/- to 1/2½ | .. |
| p | ,, rolled bars & rods | per lb. | 1/- to 1/3 | .. |
| p | ,, ,, strip & sheet | per lb. | From 1/1 | .. |
| o | Platinum .. .. .. .. | per oz. | £4 | .. |
| p | Silicium Bronze Wire .. .. | per lb. | 9d. to 11d. | .. |
| i | Steel, Magnet, acc'd'g to desc'p'n | per ton | £58 | .. |
| i | ,, ,, in bars .. .. | | £15 to £40 | .. |
| g | Tin, Block .. .. .. .. | per ton | £127 to £128 | 30/- dec. |
| g | ,, Foil .. .. .. .. | per lb. | 1/6 | .. |
| n | ,, Wire, Nos. 1 to 16 .. .. | per lb. | 1/7 | .. |
| p | White Anti-friction Metals— "White Ant" brand .. | per ton | £42 to £62 | .. |
| j | Yarns, 2/10s Grey Cotton, on sp'ls | per lb. | 8d. | .. |
| j | ,, 6 lea. Flax .. .. .. | per lb. | 5⅝d. | .. |
| j | ,, 8 ply 10 lbs. Russian .. | per lb. | 4 13/16d. | .. |
| j | ,, 10 lbs. Russian, single .. | per lb. | 4⅛d. | .. |
| j | ,, 180 lbs. Jute rove .. | per ton | £11 | .. |
| k | Zinc, Sh't (Vieille Montagne bnd.) | per ton | £25 5 | .. |

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

## ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

| | Locality. | Week ending | Receipts for the week. | | No. wks. | Total to date. | | Miles open. | * |
|---|---|---|---|---|---|---|---|---|---|
| | | | £ | £* | | £ | £* | | |
| | Aberdeen .. .. | May 7 | 1,219 | +239 | 49 | 58,923 | +12,084 | 10 | — |
| | Birmingham .. | ,, 7 | 5,379 | +403 | 19 | 98,665 | + 5,364 | 8¼ | — |
| | Bournemouth .. | ,, 4 | 973 | + 48 | 93 | 80,770 | — | 10½ | — |
| | Blackburn .. .. | ,, 6 | 866 | +142 | 6 | 5,531 | + 348 | 15½ | — |
| | Blackpool .. .. | ,, 5 | 551 | +135 | 5 | 3,594 | + 302 | 8½ | — |
| | ,, —Fleetw'd | ,, 7 | 320 | + 58 | 19 | 4,625 | — 254 | 7½ | — |
| | ,, —Lytham | Apr. 28 | 248 | — | 26 | 4,672 | + 4,093 | 7½ | — |
| | Bolton .. .. | May 8 | 1,698 | + 87 | 6 | 10,076 | — 40 | 25 | — |
| | Bradford .. .. | Apr. 30 | 4,000 | +666 | 5 | 17,802 | + 1,838 | 46 | — |
| | Brighton .. .. | May 8 | 786 | — 81 | — | 4,789 | — | 7½ | — |
| | Bristol .. .. | ,, 6 | 4,942 | +425 | — | — | — | 28 | — |
| | Devonport .. | Apr. 29 | 481 | + 60 | 17 | 7,983 | + 1,116 | 5 | — |
| Co. | Dudley—Sto'rb'ge | ,, 29 | 825 | +109 | 17 | 13,071 | + 539 | 18½ | — |
| Trac. | Gateshead .. | ,, 29 | 853 | + 37 | 17 | 14,753 | + 762 | 10½ | + ½ |
| Elec. | Gr'n'k—Pt. Glsgw | ,, 29 | 534 | — 20 | 17 | 8,147 | + 617 | 7½ | — |
| | Hartlepool .. | ,, 29 | 266 | + 36 | 17 | 4,287 | + 425 | 6½ | +2 |
| | Oldham—Ashton | ,, 29 | 557 | — 1 | 17 | 8,677 | — 504 | 8 | — |
| | Potteries .. .. | ,, 29 | 1,854 | +322 | 17 | 28,314 | + 2,388 | 28½ | — |
| | Southport .. .. | ,, 29 | 294 | + 26 | 17 | 4,435 | + 253 | 5½ | — |
| | South Staffs. .. | ,, 29 | 788 | + 60 | 17 | 12,922 | + 137 | 21½ | — |
| | Swansea .. .. | ,, 29 | 480 | + 28 | 17 | 8,056 | + 289 | 5½ | — |
| Br. & | Wolverhampton.. | ,, 29 | 359 | — 7 | 17 | 5,899 | — 274 | 10½ | +8 |
| | Yorks. Wool Dist. | ,, 29 | 600 | +242 | 17 | 9,190 | + 8,972 | 6 | — |
| | Miscellaneous .. | ,, 29 | 2,354 | — | 17 | 35,350 | — | — | — |
| | Burnley .. .. | May 7 | 984 | +251 | — | — | — | 10½ | +3½ |
| | Burton-on-Trent .. | ,, 8 | 307 | — | 40 | 18,258 | — | 8½ | — |
| | Cardiff .. .. | Apr. 30 | 1,579 | +160 | — | 8,548 | + 240 | 1 | — |
| | Chatham & District | May 5 | 607 | +102 | 18 | 9,520 | + 1,667 | 8·58 | — |
| | Cork .. .. .. | ,, 5 | 484 | — 67 | 18 | 7,264 | — 285 | 9 | — |

* Compared with the corresponding period of 1903.

| | Locality. | Week ending | Receipts for the week. | | No. wks. | Total to date. | | Miles open. | * |
|---|---|---|---|---|---|---|---|---|---|
| | | | £ | £* | | £ | £* | | |
| | Dover .. .. | May 7 | 188 | — 19 | 18 | 3,267 | — 188 | 3 | — |
| | Dublin .. .. | ,, 6 | 4,986 | + 226 | 19 | 80,877 | + 1,689 | 47 | + ½ |
| | East Ham .. .. | ,, 7 | 739 | +172 | — | 4,034 | + 542 | 5 | + ½ |
| | Glasgow .. .. | ,, 7 | 14,243 | +956 | 49 | 667,785 | +60,931 | 70 | +5½ |
| | Halifax (2 weeks) .. | ,, 4 | 2,749 | +479 | 5 | 6,974 | + 439 | 33 | +2½ |
| | Huddersfield .. | ,, 7 | 1,183 | + 89 | 5 | 6,803 | + 505 | 28 | — |
| | Hull .. .. .. | ,, 7 | 2,037 | +327 | 5 | 11,101 | + 1,060 | 13 | +2½ |
| | Ilkeston .. .. | ,, 4 | 141 | — | — | 7 953 | — | 4 | — |
| | Ipswich .. .. | ,, 7 | 401 | — | 5 | 2,329 | — | 9 | — |
| | Isle of Thanet .. | ,, 7 | 403 | — 7 | 18 | 5,434 | — 336 | 10½ | — |
| | Leeds .. .. .. | ,, 7 | 5,484 | +817 | — | 34,144 | + 2,667 | 81½ | +2 |
| | Liverpool .. .. | Apr. 30 | 10,072 | +202 | 18 | 173,810 | + 3,959 | 103 | — |
| | London C. C. .. | ,, 23 | 10,922 | +2483 | 3 | 36,751 | + 7,560 | 32½ | —7 |
| | Manchester .. .. | May 7 | 11,602 | +699 | 5 | 58,714 | + 711 | 131½ | — |
| | Newcastle .. .. | ,, 7 | 3,642 | +522 | — | — | — | 17 | — |
| | Portsmouth .. .. | ,, 7 | 1,703 | +216 | — | 9,980 | + 1,030 | 14½ | — |
| | Salford .. .. | ,, 5 | 3,967 | +851 | — | 18,330 | + 2,029 | 30 | — |
| | Sheffield .. .. | ,, 8 | 4,279 | +410 | 6 | 28,370 | + 539 | 32½ | +4½ |
| | Southampton .. .. | ,, 5 | 919 | — 15 | — | — | — | 9 | — |
| | Southend-on-Sea .. | ,, 4 | 273 | + 24 | 5 | 1,414 | + 145 | 6½ | — |
| | Sunderland .. .. | ,, 8 | 1,121 | + 93 | 5 | 6,316 | + 108 | 20 | +3 |
| | Tyneside .. .. | ,, 1 | 238 | + 90 | 18 | 5,218 | + 794 | 8·9 | + ' |
| | West Ham .. .. | ,, 5 | 741 | — | 10 | 5,017 | — | 4·56 | — |
| | Wolverhampton .. | ,, 4 | 578 | +162 | — | — | — | 7·568 | — |
| | Cen. London Rly.. | ,, 7 | 5,950 | — 12 | 19 | 131,730 | — 1,040 | 6 | — |
| | City & S. Lon. Rly. | ,, 8 | 2,546 | —156 | 19 | 57,949 | — 1,840 | 6½ | — |
| | Dublin—Lucan Rly. | ,, 8 | 115 | + 26 | 19 | 1,852 | + 110 | 6½ | — |
| | L'pool Overh'd Rly. | ,, 9 | 1,594 | + 19 | 19 | 29,507 | + 91 | 6½ | — |
| | Mersey Railway .. | ,, 7 | 1,659 | +170 | 18 | 26,505 | + 6,393 | 4½ | — |

## INSTITUTION OF ELECTRICAL ENGINEERS.

### POWER STATION DESIGN.

By C. H. Merz, Member, and Wm. McLellan, Associate Member.

(*Paper read in London, April 28th*, 1904.)

#### Introduction.

It is proposed in this paper to discuss some of the salient features of a station for power supply, in the design of which station all other considerations are made subservient to the commercial success of the undertaking as a whole. We do not suggest that the power station, as distinct from the outside system, is the more important section—on the contrary, it should not represent more than 50 per cent. of the total expenditure. It is, however, a simpler matter to compare the details of design and cost of this part of an undertaking with the corresponding part of another than is the case with the outside or distribution system. We shall omit particular reference to the generation of electrical energy either from waste products or by water power—the latter is not of great importance in this country, while the former is in itself of sufficient interest to demand a whole paper for its adequate treatment.

The principles of power station design referred to hereafter are applicable to all electricity works, large or small, whether they be designed for power supply, traction, or lighting, though in small stations some of the considerations may naturally lose force for commercial or other reasons. Power stations are designed for numerous purposes, from the small station for a town lighting or traction system to the large station for dealing with all the requirements of an industrial neighbourhood; it may therefore be advisable, although the general principles of design are identical, to say at the outset that many of the remarks as to detail which we shall make apply more particularly to the power station (5,000 kw. or over) of a power supply undertaking—that is to say, of an undertaking whose object is to supply all the requirements (power, traction and lighting) of a district extending over a considerable area.

The commercial success of such an undertaking is absolutely dependent upon the cheapness and reliability of the supply. It may be urged that this is no new phase of the supply problem; but the argument, though possibly correct in principle, is so wide of the mark in degree that if a station for power supply were designed on similar lines to many existing power stations for traction and lighting purposes commercial failure would almost certainly result. In the case of a tramway system the capital expenditure on the electrical equipment is not a very large proportion of the cost of the whole system; large sums, therefore, can be, and frequently are, expended on elaborate and ornamental buildings, on highly finished equipment, on the provision of an excessive amount of spare plant, and on unnecessary duplication of auxiliary machinery, without appreciably affecting the commercial success of the system.

In the case of power supply, however, there is a limit in price below which a supply company must keep if it is to get consumers at all. This limit is low because many large individual consumers are very favourably situated from a power generating point of view, and a power company can therefore only attain success by giving due consideration to the factors governing economical production. Reliability of supply must, however, take precedence over everything else, even over economy of production. It is impossible to contemplate interruption of supply to a manufacturer, for if this happens a power company has failed in its purpose. To meet this condition involves careful and substantial engineering design and the use of only the best and most reliable apparatus obtainable. It further involves a reasonable allowance of spare plant and renders essential simplicity of design and standardisation of details.

Before entering on the main object of this paper, it may be useful to analyse more closely the relative importance of the power station and the distribution system. Since the early days of the distribution of electrical energy an amount of attention has been directed to the power station, as compared with the distribution system, which is hardly warranted by its importance from either an engineering or a commercial standpoint. This is no doubt partly due to the fact that it is, so to speak, the mainspring of the whole system, and partly because the merits or demerits of its design are ever open to observation. The importance attached to the power station probably accounts for the lavish and unnecessary expenditure which has in many cases been bestowed upon it.* It may be worth while to carry the suggested comparison into detail, if only because the conclusions to be drawn materially affect the expenditure on the power station itself.

1. The distribution system of a power scheme will usually consist of a three-phase supply at 40 or 50 cycles per second. We do not refer to the voltage, as this depends, to a great extent, upon the area covered, and, in any case, it can easily be transformed. The system of supply having once been decided upon, and the cables laid, it is more or less permanently settled for better or worse, and cannot be changed without great expense.

2. The expenditure upon the distribution system will probably, in the majority of cases, amount to more than 50 per cent. of that on the whole scheme, especially if the consumer's installation be taken into account. This, whether supplied by the power company or not, is really part of the system, in that the company must bear the expense of any alteration necessary on account of change of system.

3. The manufacture of cables is well understood, and if they be properly designed and laid, they are subject to a very small repair account. A smaller depreciation account is, therefore, justifiable than in the case of the power station.

4. Large power schemes will probably eventually consist of a network of transmission cables, sub-stations, and distributing cables, supplying all the power requirements of a neighbourhood, and drawing a supply from more than one power station, the latter being located where electricity is to be obtained most cheaply from either coal or waste products.

5. The distribution system has a comparatively high efficiency, probably not less than 75 per cent.

6. On account of the high initial cost of installing the distribution system, in taking up ground, &c., and the difficulty of making small beginnings and economically adding to them hereafter, the distribution system should be, and generally is, put down with more margin for future requirements than is the power station.

On the other hand—

1. A power station has a comparatively low efficiency, not more than 10 per cent.; there is thus room for large improvement in the generation of power. For this reason the depreciation account must necessarily form a much higher percentage of the capital cost than in the case of the distribution system.

2. A power station is capable of easy extension without affecting in a very marked degree the ultimate cost. It can therefore be begun on a smaller scale.

3. It may pay in the future to change even the location of the power station, and to feed the system from some other site or sites where energy can be more cheaply generated.

It is essential for the designer to keep before him the two main considerations, "reliability of supply" and "economy of production." The latter may be conveniently sub-divided into running charges and capital costs. Early engineers, whether civil, mechanical, or electrical, were justifiably content if the work for which they were responsible proved reliable, operating and capital costs being minor considerations. The necessity for low operating costs was next fully recognised, so much so that this consideration was allowed to overrule all others, even that of reliability—certainly a backward step. The fact that a project must work well and efficiently, and that it must do both these with a minimum of initial expenditure, is now realised as essential. No engineer can afford to disregard *low capital cost*, which is equivalent, commercially, to *low annual cost*. The importance of keeping the capital cost as low as possible, especially in the case of the power station, may be fully appreciated by a careful consideration of its characteristics as referred to above. We do not think

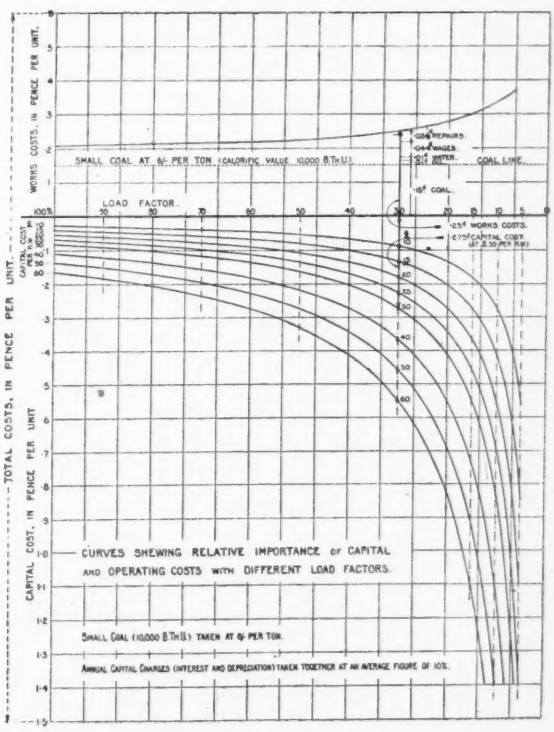

WORKS COSTS, IN PENCE PER UNIT.
SMALL COAL AT 6/- PER TON (CALORIFIC VALUE 10,000 B.TH.U.)
LOAD FACTOR.
CAPITAL COST, IN PENCE PER UNIT.
TOTAL COSTS, IN PENCE PER UNIT.
CURVES SHEWING RELATIVE IMPORTANCE OF CAPITAL AND OPERATING COSTS WITH DIFFERENT LOAD FACTORS.
SMALL COAL (10,000 B.TH.U.) TAKEN AT 6/- PER TON.
ANNUAL CAPITAL CHARGES (INTEREST AND DEPRECIATION) TAKEN TOGETHER AT AN AVERAGE FIGURE OF 10%.

Fig. 1.

it is wide of the mark to suggest that 10 per cent. per annum should be considered as sinking fund, in deciding whether to spend more money than is absolutely necessary on any particular section of the plant in a power station, in order to secure lower running costs. In stating this we have specially in mind the liability of change in the generation of power, both in method and in the location of the power station. The relative importance of capital cost and running cost may be seen at a glance for any particular values of either load factor, capital cost, or running cost, from the curves attached. (See fig. 1.) From these curves it will be seen that a reduction of the

* When we consider that a boiler only costs £2 or £3 a kilowatt, and a turbine or high-speed reciprocating set £10 at the outside, it is surprising to find power stations running out (as they still do in many cases) to a total cost of £40 or even more per kilowatt. In other words, the mere collecting and joining together of the principal apparatus may cost three or four times as much as the apparatus itself.

capital outlay by £1 per KW. has a greater effect on the running costs than has a reduction of the coal bill by 6 per cent., on the basis of coal at 6s. per ton. This applies with a load factor as high as 30 per cent.; it is therefore evident that for lower load factors the question of limiting capital expenditure becomes of overwhelming importance as compared with that of reducing running costs.

There are one or two general principles which it may be worth while to discuss, each having special reference to reliability of supply and economy of production. They are:—

1. Simplicity of design.
2. Sub-division of plant and apparatus.
3. Labour-saving devices.
4. Provision for extension.

1. *Simplicity of Design.*—Simplicity of design is desirable, apart from (as well as on account of) the question of economical production, and, generally speaking, it may be accepted that no complications introduced to facilitate the repair of a breakdown are justified should the complications themselves increase materially the risk of breakdown. That all the earlier station engineers should consistently disregard this axiom was perfectly natural, as, in view of the comparatively unreliable apparatus at their disposal, they were more impressed by the necessity of speedy repair than by the importance of avoiding a breakdown altogether. In fact, they came to regard breakdowns as inevitable, devoting their attention to minimising their effect rather than to reducing the amount of apparatus in which a breakdown could occur. This line of procedure, while possibly justifiable in the earlier stages of the industry, has in many cases been pushed too far. In some stations the designers have apparently set themselves the task of rendering possible every conceivable combination of boiler and engine, engine and exciter, pump and boiler, &c. Ten years ago Mr. Ferranti actually practised this doctrine of simplification, more especially with regard to the electrical side of the station, and as an example of its systematic and logical application the general arrangement of a Ferranti single-phase board is unsurpassed.

In the design and general arrangement of the mechanical portion of the station equipment the complication which formerly existed now appears to be diminishing. For instance, at one time a ring steam main was considered necessary, but it was speedily realised that the inherent objections were very numerous, most engineers returning to the sub-divided straight main into which all boilers fed and from which all engines drew their supply of steam. Fortunately cases of a burst steam pipe in a station have been rare, but the failure of a pipe or valve at full load anywhere near the middle of a main would probably result in shutting down the whole station, whether a ring main were used or not.

2. *Sub-Division of Plant and Apparatus.*—The only way to remove all risk of a complete shut-down due to the failure of a steam pipe is to sub-divide the boiler house plant into a series of groups, each group having no connection with its fellows.* In fact, it is now considered imperative in a large power station to sub-divide all parts of the apparatus from the boiler house to the switchboard into a series of units, each complete in itself. This is certainly essential to reliability of supply, and it is in no way inconsistent with economy of production. From the point of view of reliability of supply, if trouble is to be had with anything it will be obtained by crowding together all kinds of water and steam pipes in one trench. If trouble is to be had with auxiliary apparatus, it will be obtained by locating it with other apparatus, and not sub-dividing it properly. If trouble is to be had with switchgear, it will be obtained by fixing many cables or connections for different purposes, either on one panel, or in one partition, or in one cable trench, as the case may be.

3. *Labour-saving Devices.*—It is sometimes justifiable to disregard the question of economical production on account of the difficulty of obtaining labour, especially intelligent labour, at a reasonable price. To obtain suitable labour becomes more and more difficult every day, not (we hope) because the supply grows less, but because the demand increases faster than the supply. This matter is specially referred to, as the authors have found it difficult to justify the inclusion of a great proportion of labour-saving apparatus by any actual calculation of possible economies in capital or running costs. Take even the ordinary mechanical stoker; we doubt very much if, taking into account first cost and repairs and also efficiency, this is in practice justifiable except in order to meet the labour difficulty. Certainly in the case of most coal-handling plants it will be found that the cost of labour saved is more than counterbalanced by the charges for interest, depreciation, and repairs on the elevating and conveying apparatus. We have known a case in which the capital and repair charges exceeded by 200 or 300 per cent. the economy in wages—there obviously the expenditure was not justified.

Before expending money in labour-saving devices the *pros* and *cons* of the case should be systematically considered. On the one side should be put capital charges, taken at not less than 15 per cent. on the capital cost, and repairs—the latter to be estimated. On the other side should be put the saving in labour. The expenditure may be justified if the two sides balance, not otherwise, unless, of course, the case be qualified by the existence of special labour difficulties. Incidentally it may be remarked that the adoption of labour-saving apparatus may either increase or reduce reliability of supply. It will increase it in so far as the human element can be safely replaced by automatic machinery. It will reduce it, due to the absence of any one to look after it or to take its place should it break down, if the apparatus installed be too complicated.

4. *Provision for Extension.*—Frequently in the design of a traction station engineers have considered it sufficient to merely provide for immediate requirements, or to so arrange the station that it is capable of extension to a certain definite number of additional units of specific size only. In stations essentially for the wholesale supply of power this does not seem sufficient. Not only are future requirements unknown, but it is difficult to foresee the type of plant which it may be advantageous to install in the future. For instance, a station made for half a dozen reciprocating sets would provide accommodation for three times as many turbines, in which latter case a difficulty would be met with in providing boiler space with reasonable lengths of steam piping. This is a difficult matter to deal with; not only has one to consider the use of turbines if they are not installed in the first instance, but to make a choice of the different types of turbine, vertical and horizontal, and to consider the further possibility of adopting gas engines later.

Power stations for wholesale supply, if the eventual capital expenditure per unit sold is to be kept down, must not be designed for to-day. There is nothing which increases the station capital account so rapidly, and prevents that gradual decrease of capital expenditure per unit sold which should take place with the growth of a system, as alterations to existing work and rearrangements in order to meet increased output. It is possible in laying out a station to avoid placing chimneys, flues, offices, and elaborately built brick ends so as to interfere with extensions to either boiler house or engine room, though it is to be feared that this is not always done. In deciding upon general arrangements, therefore, or the position of any particular piece of apparatus, or the size of any pipe or trench, it is essential to consider whether such decision is likely to affect (or to be affected by) future extensions.

Having referred to the main principles governing power station design, we shall proceed to discuss some of their effects on actual design, on the assumption that the power station under consideration is for the supply of energy as three-phase high-tension current at 5,000 volts or over. To illustrate discussion we make frequent reference to certain designs for which we, as engineers, are responsible, our justification for this course being that we are necessarily familiar in these cases with the reasons governing the detail design and the choice of apparatus.

### 1. Type of Generating Plant.

Although the general design of the main building should permit of any type of plant being used for extension, it is obviously necessary to settle on the type to be adopted in the first instance before proceeding with the detail design of any portion of the structural work. While, therefore, it would appear the natural sequence to deal with the buildings and general arrangement before discussing the generating plant, we propose in this paper to adopt the course which would be followed in actually designing a generating station, and to discuss first the relative merits of various types of prime movers. The most convenient way of doing this is to consider them in the order of their development, viz.:—

1. Slow-speed reciprocating engines.
2. High-speed reciprocating engines.
3. Steam turbines.
4. Gas engines.

Comparisons have been so frequently instituted between the first two types and their relative merits so thoroughly discussed, that it would serve no useful purpose to carry the discussion further. Before, however, proceeding to group together slow and high-speed reciprocating engines to compare their merits with those of the turbine, we will briefly touch on their chief characteristics. High-speed apparatus should obviously for the same power cost less than slow speed. It will, moreover, take up less room. On the other hand, the advocates of slow-speed engines claim that the repair bill of a high-speed engine is higher, and the economy not so good as in the case of a slow speed set. It is only in this country that the question as between the two types has arisen at all—neither on the Continent nor in the United States has any progress been made with high-speed apparatus, and the perfection to which high-speed engines have been brought in this country is all the more creditable in view of relatively slow progress in some other branches of the industry.*

Every year steam turbines claim increasing attention.† They have already been adopted for the largest new stations in this country, on the Continent, and in America. Opinion is, however, still divided with regard to their merits, and we are therefore, perhaps, justified in dealing with the question at some length. The present position of steam turbines may be said to be almost entirely due to the indefatigable energy of the Hon. C. A. Parsons, who has laboured many years on their development. A Swedish engineer, De Laval, has also been engaged on the subject for nearly, if not quite, as long. His turbine, however, runs at so high a speed (of the order of 10,000 r.p.m.) that it is impracticable except in comparatively small sizes.

* When the initial capacity of a station is comparatively small and a cross connection is considered desirable, it should be made through a length of pipe having stop valves at each end.

* See *Proceedings of the Institution of Civil Engineers*, vol. cli.: "High-speed Electrical Generating Plant," by T. H. Minshall. According to figures recently published, high-speed engines have been built with a consumption of only 16 lbs. of water per kilowatt-hour (steam at 200 lbs. and 200° F. of superheat)—which figure will bear comparison with the very best slow-speed results.

† See paper before the Municipal Electrical Association:—"Steam Turbines," by S. E. Fedden, July, 1902. Also "Some Notes on Steam Turbo-Electric Generating Plants," by George Wilkinson, before the Leeds Local Section, Institution of Electrical Engineers, October, 1903.

Of turbines* more recently placed on the market, the best known is perhaps the "Curtis,"† which has been developed by the General Electric Co., of America. Other types are the "Rateau,"‡ manufactured by the Maschinenfabrik Oerlikon, Zurich, and the "Stumpf," developed by the Allgemeine Elektricitäts Gesellschaft, Berlin. In addition to these there are various modifications of the Parsons turbine manufactured by different firms.

*(To be continued.)*

### Glasgow Section.

The fourth annual report of this Section shows a total membership of 207, with a gross increase of 19 in the 12 months, and a net increase of four. The office-bearers for the 1904-5 session are as follows:—

*Past Chairmen* .. .. .. .. .. Lord Kelvin, G.C.V.O., &c., &c.; Prof. Magnus Maclean, D.Sc.; Henry A. Mavor; W. A. Chamen.
*Chairman* .. .. .. .. .. .. Robert Robertson.
*Vice-Chairman* .. .. .. .. .. Prof. Francis G. Baily.
*Hon. Secretary and Treasurer* .. .. E. George Tidd.

*Ordinary Members of Committee:—*

1. Prof. A. Gray, LL.D.
2. M. T. Pickstone.
3. Wm. W. Lackie.
4. J. M. M. Munro.
5. John Macfee.
6. Sam Mavor.
7. A. W. Stewart.
8. E. T Goslin (*Representing Associate Members*).
9. J. R. Stothert (*Representing Associates*).

### Birmingham Section.

The Committee has prepared the following list of officers to act during the session, 1904-5:—

*Past Chairmen*—Sir Oliver Lodge, F.R.S. (1900-2).
Henry Lea, M.Inst.C.E. (1902-3).
J. C. Vaudrey, M.Inst.C.E. (1903-4).

*Chairman*— *W. E. Sumpner, D.Sc.*

*Vice-Chairman*—*R. Threlfall, F.R.S.*

*Present Ordinary Members of Committee* (*remaining in Office*)—

T. Hawkins.
R. H. Housman.
J. H. McLean.
W. O. Rooper.
C. E. C. Shawfield.
A. M. Taylor.

*Ordinary Members of Committee* (*new nominations*)—

*R. A. Chattock.*
*S. H. Holden.*
*R. C. Jackson.*
*R. K. Morcom.*
*P. Orsettich.*

*Hon. Secretary*— D. K. Morris.

*Assistant Hon. Sec.*—J. K. Catterson-Smith.

The Committee's nominations are given in italics.

## VISIT OF THE STUDENTS OF THE I.E.E. TO ENGINEERING WORKS.

(*Concluded from page* 723.)

### The Midland Electric Corporation.

The area supplied by this station is 70 sq. miles, in Worcestershire and Staffordshire. Electricity is generated at a pressure of 7,500 volts, and transmitted at this voltage to the sub-stations, of which there are seven. From the sub-stations, distribution takes place in bulk to works or street transformers, at 2,700 volts (the maximum allowed by the Board of Trade Regulations is 3,000 volts), and to other customers for lighting at 200 volts. One of the sub-stations is equipped with rotary converters, and continuous current at 500 volts is supplied for tramway purposes. The generating plant comprises one 1,500-kw. two-phase Ferranti alternator, driven by a Yates & Thom engine, and two 800-kw. two-phase Ferranti alternators, driven by Ferranti engines. The mains are all B.I.W. two-phase "twin" three-conductor, lead-covered and juted, laid solid in stoneware ducts. There are about 44 miles of extra high-pressure mains, 26 miles of high pressure, and 40 miles of low pressure. The principal customers at present are the Wolverhampton and District Tramways, Tipton U.D.C., and Wednesbury U.D.C.

The power station is very well situated, being close to the coal pits, and having an ample water supply from the canal. This is greatly in favour of cheap production, very few stations being so well situated. The sub-station at Ocker Hill was also visited.

The Wednesbury U.D.C. takes its supply in bulk at a pressure of 200 volts on the maximum demand system, and converts the two-phase alternating current supply by aid of motor-generators into direct current at 230 volts for distribution. The station contains two 75-kw. Phœnix motor-generators and two 10-kw. Westinghouse boosters for the battery, which consists of 117 British Schultz 1,000 ampere-hour cells.

On the following day the party made Wolverhampton their centre, and in the morning inspected works of the Electric Construction Co. Though, for an electrical firm, this is an old-established one, the machinery and organisation are well up to date. Motor driving is adopted, and in addition compressed air is supplied for special tools. A very fine new shop has lately been erected for dealing with very large generators. Amongst other machines a 1,500-kw. two-phase generator for Leeds, and a 750-kw. traction generator, were in course of construction here.

The Wolverhampton Corporation Electric Power Station was visited in the afternoon. Here the generating pressure originally in use was 2,000 volts continuous current. All these machines have now been removed, with the exception of one which is used for series arc lighting. The generators are all shunt wound, for 550 volts, and by varying the excitation can be used to supply the three-wire lighting system at 440 volts across the outers, or 500 volts for traction. There are separate traction and lighting batteries of 1,000 and 1,200 ampere-hours capacity respectively.

The present generating plant consists of one 2,000-volt 70-ampere Belliss-Parker set, and the following sets at 440 to 500 volts as required:—Two 500-kw. Willans-E.C.C., one 500-kw. Peache-E.C.C., and one 200-kw. Belliss-Parker. Two additional sets of about 500 kw. will shortly be added; possibly these may be turbine sets. The automatic circuit-breakers on the traction panels are very frequently opened, as the cars so often pick up pieces of iron on the track, and these cause short circuits when approaching points and crossings, as they connect the live contact blocks to the running rail.

After viewing the power station, a move was made to the car-shed, where the Lorain surface-contact system of electric traction was fully explained. During the past year over 50 deputations have made Wolverhampton their Mecca, in their search for an ideal system of electric traction, so that the officials are well accustomed to visitors.

Mr. C. Shawfield, the borough electrical engineer, very kindly gave the party a number of interesting details of his experience of the operation of the contact studs and collecting apparatus, gained from his observation since they have been in use. Mr. Shawfield is thoroughly convinced as to the reliability of the system, the actual journeys lost owing to faulty contact studs being only three in 10,000. The average leakage taken over the whole year, wet and fine weather, is $\frac{1}{10}$ of an ampere per car in service, which, it must be admitted, compares very favourably with overhead construction.

Once a week the whole of the contact boxes are tested by connecting a voltmeter between the stud and the rail; those at junctions and crossings, however, are tested daily. The failures have been very few, 90 per cent. of the contact boxes not even having been opened for inspection; part of the remainder have been opened to see the effects of wear upon them, and in those that have proved faulty, it is very rarely found that the fault is much more than a slight leakage. The ratio of the cost of the surface contact system to the cost of overhead construction is, approximately, for single track 6 : 5, and for double track 12 : 5.

On June 29th, Mr. Shawfield proposes to read a paper on "The Commercial Practicability of Electric Traction by Surface Contacts" before the M.E.A. at Derby, in which he hopes to deal fully with a number of practical points regarding the results of the working of the system at Wolverhampton.

On Thursday morning the party divided into two sections, one going to Messrs. Player's works and the other to those of the Lanchester Engine Co. Messrs. W. & J. Player's speciality is the manufacture of their "Power hammer," a tool which is of special interest at the present moment, when so many works are being converted to electric driving.

The general arrangement of this tool is similar to the steam hammer, but placed at the back of the hammer cylinder is a single-acting pump cylinder, the piston of which is driven by means of a connecting rod and crank, which in turn is driven through gearing by an electric motor, or is belt driven. The pump cylinder compresses air into and extracts it from the hammer cylinder through a connecting passage at the top end, thus causing the hammer piston to rise and fall. The pressure on the hammer piston can be varied by means of a simple valve which allows a part of the charge of air in the pump cylinder to escape to the atmosphere, and also by its aid air can be imprisoned underneath the piston; thus a very good control is obtained over the blow, an even better control than in the case of the steam hammer.

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* The only turbines of large size which have been running any considerable time are those of the Parsons type made by C. A. Parsons and Co., though the Westinghouse Co. and Messrs. Brown, Boveri (who manufacture the Parsons turbine under licence) have also started up some large turbines within the last 18 months. The following table gives a few particulars of the various types of steam turbines:—

| Type. | Output kw. | Speed r.p.m. | Approximate peripheral speed in ft. per second. | Expansion stages. | Total number of rows of blades. | General characteristics. |
|---|---|---|---|---|---|---|
| Parsons.. | 1,500 | 1,200 | 100 to 220 | Continuous. | 78 | Drum construction—fall of pressure equally divided between stationary and moving blades. |
| Rateau .. | 1,500 | 1,200 | 150 to 200 | 25 | 25 | Disc construction—fall of pressure occurs only at nozzles in stationary discs. |
| Curtis .. | 1,500 | 750 | 400 | 4 | 8 | Disc construction—arranged vertically, two rows of revolving blades to each set of expanding nozzles. |
| Stumpf .. | 1,500 | 3,000 | 1,400 | 1 | 1 | Expanding nozzles, single disc, buckets similar to Pelton wheel. |
| De Laval | 200 | 10,600 | 1,400 | 1 | 1 | Expanding nozzles, single disc, drives dynamo through helical gearing. |

† See *Proceedings of the American Philosophical Society of Philadelphia*, April, 1903. "The Curtis Steam Turbine," by W. L. R. Emmet.

‡ See paper by Prof. Rateau before the Conference of the Institution of Civil Engineers, June, 1903. (*Engineering*, July 3rd, 1903, *seq.*)

The Lanchester Engine Co. have large works entirely devoted to the manufacture of automobiles. The equipment of the factory is very modern, and includes a number of special machine tools of very ingenious construction.

In the afternoon the visitors made their way to Messrs. Belliss and Morcom's engine works. Though not a new works, it appears to be so, as it has been enlarged, rearranged and equipped with the modern tools necessary for the high degree of accuracy needed in work of this class.

The Chamberlain & Hookham electricity supply meter factory was the first item on the programme for Friday. The entire apparatus is made here, even to the counting mechanism, which is usually considered to be the speciality of the German and Swiss clock-makers. A new feature to which the firm are devoting special attention is the prepayment meter for both direct and alternating current, for which there is a large demand for small consumers' installations.

In the afternoon the party again divided into two groups, one going to Messrs. Stewarts & Lloyd's tube works at Halesowen, and the other to the Birmingham Small Arms Co.'s factory at Small Heath.

In the evening a dinner was arranged at the Midland Hotel, for those taking part in the visit, with Mr. H. D. Symons, chairman of the Students' Section of the I.E.E., in the chair, and Mr. Vaudrey, chairman of the Birmingham Local Section, as the guest of the evening. The toast list includedthe President and Institution, Mr. J. C. Vaudrey, Mr. H. D. Symons and Mr. A. G. Ellis, the hon. secretary, to whose exertions much of the enjoyment of the visit was due. During the evening songs and recitations were contributed by members of the party.

This social function did not, however, end the proceedings, for yet another visit had been arranged to the Water Street Power Station of the City electricity supply department. This station generates at 440 volts for distribution on the three-wire system in the neighbourhood, 480 volts for working in conjunction with the station at Dale End, and 500 volts for electric traction supply. There are two engine rooms, one on each side of the boiler house; one contains four Belliss-Crompton 189-kw. sets and three Belliss-E.C.C. sets of similar capacity, the rated output being 800 amperes at 220—260 volts; the other engine room contains four Willans-Mather & Platt 500-kw. sets and one 500-kw. Parsons steam turbine and dynamo. A similar machine is on order. This engine room also contains step-up rotary transformers used in connection with the Edgbaston supply, current being transformed from the bus-bar pressure to 1,200 volts for this purpose. The Parsons steam turbo-dynamo is designed for a maximum voltage of 530 and a maximum current of 1,090 amperes when running at 1,800 revolutions per minute. The turbine itself requires very little attention, but the dynamo brushes have to be taken out and trimmed every other day. The brush gear is fitted with a special rocking attachment operated by steam from the turbine.

The boiler equipment consists of 14 Lancashire boilers, fitted with mechanical stokers, and two Babcock & Wilcox boilers. Town water, which has 15° of hardness, is used for the boiler feed; no softener is used, soda crystals being added inside the boiler instead.

A new power house, on the canal bank, is about to be equipped, which will generate partly three-phase alternating current at 5,000 volts and partly direct current at 500 volts. The alternating sets will be of 1,500 kw. capacity, Belliss-Westinghouse, and the direct current sets 1,500 kw., Belliss-Dick, Kerr.

A special car conveyed the party from these works to the new power station of the Birmingham University. This station is very fully equipped, and serves as an indication of what the remainder of the equipment and buildings will be like. The plant consists of a 375-kw. Westinghouse gas-dynamo, a 90-kw. Premier-Westinghouse gas-dynamo, a 75-kw. Maclaren-Westinghouse three-phase alternator, a 75-kw. Willans-Siemens set, a 75-kw. Belliss-Peebles set, and a 20-kw. De Laval-Greenwood & Batley turbine dynamo.

A 37·5-kw. Westinghouse rotary converter, and a special switch-board of the Westinghouse type with 13 panels, are also provided. Careful attention has been paid to the auxiliary plant, which is driven by three-phase motors.

Though much can be said both for and against making such visits as are briefly described above, undoubtedly the advantages outweigh the disadvantages, and all who took part in this visit realised that the time had been well spent in gaining a good insight into how other people did things, both in the particular direction in which they were specialising, and in general engineering. Through the kindness of the various proprietors of works, an opportunity was given for seeing operations and processes which students will have difficulty in arranging to see when they are further advanced in their profession, especially in this country. It is hoped that even a larger number will take the opportunity next year of joining in the visit.

## ELECTRIC COAL-CUTTING.

We have received copies of two papers recently read before the Institution of Mining Engineers, one on "Electric Coal-Cutting," by Mr. W. Walker, and the other on an "Electric Heading Machine," by Mr. Percy C. Greaves, both of which are interesting, inasmuch as they give the results of the experience of the writers in the use of such machines.

In introducing the subject, Mr. Walker says:—"Probably all mining engineers would readily admit that coal-cutting machinery could not be profitably applied to all coal seams at present being worked, for one or other of the following reasons:—(1) Seams so easily wrought that only a small charter-price per ton is paid; (2) seams intersected by numerous faults of various throws; (3) seams nearly exhausted; (4) seams worked by the bord and pillar system; and (5) seams exceeding 6 ft. in thickness, and having a bad roof," which is rather too sweeping a statement, and, with the exception of the third reason, cannot be upheld, and even this would depend upon the quantity of coal still to be worked. If a seam is so easily wrought that it could be undercut by hand for the same price per ton as by machine, the latter would still have the advantage in the larger percentage of round coal. Seams intersected by numerous faults can be worked by an electric "pick" machine, or "puncher," which is also applicable to the "bord and pillar" system of working, though such machines have met with little favour in this country, and probably a really successful machine of this type has yet to be designed. Compressed air and electric machines of this type have been working successfully for many years past in America and, though we have no information as to the working and cost of upkeep of the electric machine, the compressed-air "pick" is beyond the experimental stage. One serious objection to them is the excessive vibration due to the rapidly repeated blows, which is hard upon the operator. Much more attention might be given to this type of machine by makers of coal cutters, as it has several advantages; it is light, easily moved about, can be worked in narrow places, and the percussive action is really the ideal method of cutting, especially in hard material, and one very decided advantage is that it can cut in a vertical as well as a horizontal direction. As to (5), seams of 6 ft. and over may be cut by machine quite as well as thin seams, and, what is more, the coal may not only be cut, but conveyed and loaded into the tubs by machine, as is already being done in some thin seams. There is no doubt machinery will play an important part in coal getting in the near future, and as to the advantages of coal-cutting machines, Mr. Walker says: "There are also numerous old collieries where the use of coal-cutting machines would have saved fortunes, had it been possible to have introduced them when the collieries were in their infancy," and, "The tendency of workmen is to work less time and to maintain the same wage, and if this cannot be done in one mine they flock in large numbers to new collieries with thick seams and good holing, thereby creating a scarcity of workmen at the collieries which are working their seams with hard holing. Coal-holing machines are thus becoming a necessity in thin seams with hard or moderately hard holing."

Mr. Walker's first experience was a failure, both the disk and bar-type machines being tried, but both unsuccessfully, the difficulty being ironstone balls from 1 in. to 3 in. in diameter, lying more or less in pockets, in the fireclay floor which the machine had to cut, and in the author's opinion there is no machine on the market that could successfully be applied to this seam. Possibly, however, the "pick" type of machine would have proved successful had it been tried.

Mr. Walker next tried a bar machine in another seam with an exceptionally hard holing, so hard that there was considerable difficulty in getting men to work the seam. The holing was in fireclay 4½ in. thick, very hard and compact, and below this was fireclay mixed with ironstone balls, and the greatest length ever holed by hand for six days of work was 18 yds., 4 ft. under, against 175 yds. for five days by machine. As to depth of undercut, the author tried bars 4½ ft., but is of opinion that a 4 ft. tapered bar is the longest that can be used successfully, chiefly on account of the difficulty in removing the dirt from the extreme end of the cutting. Bar machines are usually fitted with tapered bars, mainly because the cut is more or less tapered, being greater at the front than at the back, which allows the coal to fall forward somewhat, and to be more easily got at by the loaders, but on this point Mr. Walker says: "The difficulty experienced by the 4½ ft. bar suggested to the writer that a parallel bar should be used, and, if successful, it would remove several of the important disadvantages of the tapered bar, as follows:—(1) The periphery speed of the thin end of a tapered bar is much less than at the larger end. For example, if the tapered bar makes 400 r.p.m., and the circumference over the cutters at each end of a 4-ft. bar is 21 and 16½ in. respectively, the speed travelled per minute by the two ends is 700 and 550 ft. respectively, or a difference of 27 per cent.; (2) The hardest part of holing, when done by a machine, is towards the extreme end of the cut. The front part is more or less . . . . . affected by the weighing of the last web of coal and by the action of air and moisture. This part is therefore more easily cut, but the extreme end always retains its original hardness, and consequently the periphery speed of the cutter bar at this point should be greater rather than less; (3) While the tapered bar cuts less dirt than a parallel bar would, yet the difficulty of removing the last three or four inches is great; whereas with a parallel bar this difficulty would be largely removed, and would thus facilitate the falling of the coals," which is at direct variance with general practice, though in this case it proved eminently successful, and, what is difficult to account for, used less power. It is generally accepted that the harder the material the slower should be the cutting speed, but with a greater pressure upon the tool. At the end of a bar 4 ft. long where the pressure is applied at one end, the pressure at the extreme end will be somewhat less—depending upon the size and stiffness of the bar, but it will always be less, consequently there is no need to reduce the periphery speed, and further, the elasticity of the bar will cause it to have a sort of hammer-chipping action, which is evidenced by the fact that in this case the holing dirt towards the extreme end was not pulverised or ground into dust, but chipped off into pieces about the size of a nut, which were more readily removed; and in all probability this accounts for the good results experienced by Mr. Walker with the parallel bar.

Mr. Walker then deals with *road-laying*, which ought to be carefully done;—*Cutters*, the exact shape of which can only be ascertained by experiment; he prefers to change the cutters in the bar, instead of changing the bar with another already charged with sharp cutters, and the success of the machine depends largely upon the attention the cutters receive;—*Coal face*, which should be straight;—*Cleaning out dirt*, which is partly done by the worm on cutter-bar and partly by hand, and "the trailer bar travelling behind the cutter-bar can be made to do much or little in bringing out the holing dirt. . . . but it is not wise to make it bring out too much dirt, because this will be at the expense of the cutting speed of the machine. There is, however, an efficient medium, and that is to arrange so that it brings out . . . . about one-third of the dirt made, the remainder being removed by the man employed for the purpose." Here, then, is room for the inventor.—*Holing or heads for the machine*, which are starting and finishing places prepared by hand, which are expensive and ought not to be required. "The bar machine is supposed to cut itself into a solid face, but the wear and strain in hard holing, are such as to prevent it from being recommended or adopted."—*Machine-cut coal, and Weighting of coal face*, which mainly concern the mining engineer, and *Reports* which are full and complete. A table is given recording the details of the working of the machine daily for three months, which is useful and instructive, and gives one a good idea of the little troubles and difficulties that occur when running a coal-cutting machine; whilst no electrical breakdowns to the machinery are recorded yet, the cable fused on two occasions, and it seems a pity no explanation of the cause is given. An interesting discussion follows.

Mr. Greaves describes a different type of coal-cutter, viz, a "heading" machine for driving straight work for a considerable distance, which was necessary to be done, and for which work according to the price list the men would be paid 9s. 7d. per yard; but they demanded 11s. 3d. per yard of heading 9 ft. wide, which the management could not agree to pay. Mr. Greaves could not find a British machine, and, unfortunately, had to get one from America, the "Jeffrey." This machine is 18½ in. high without the runners, and 21 in. high on the runners, and weighs approximately 30 cwts. It consists of a moving frame, round which the chain carrying the cutters travels, with the motor and gearing fixed on it. This frame travels through guides on a stationary frame resting upon the floor of the seam, is 9 ft. long, and fixed in the direction of the cut by means of two jacks. The motor of 15 H.P. runs at a speed of about 900 r.p.m., is of the open-running type—which is not desirable—and the connections for the trailing cables and plugs are fitted with a bayonet-socket arrangement to prevent them from being inadvertently pulled off. The chain is composed of links and tool-holders, the latter being set at different angles, so that straight tools can be used; but it was found advisable to bend the top cutters and make them pick pointed, the section of the steel being ¾ in. × ½ in. There are 45 tool-holders, and the chain runs at a speed of about 300 ft. per minute. The machine is set end on, in front of the face, and undercuts to an average depth of 5 ft. 7 in., the width being 3 ft. 8 in., and the thickness of the cut 4¼ in. The rate of speed for cutting was 2 ft. per minute, but it was found advisable to reduce the feed to 1 ft. per minute, and at this rate the machine took 26 amperes at 480 volts, or, say, 16½ H.P., so that the machine is still somewhat overloaded, though as the length of time occupied in making a cut is only 6 minutes there is not much fear of over-heating, but evidently the motor with the original feed was vastly too small for the work. Why makers will persist in overloading the motors in coal-cutting machines is difficult to account for, but it is a great mistake. After making a cut, the machine can be withdrawn in 30 seconds, and so soon as the first cut is made, the jacks are released and the machine is pushed by means of iron bars into position for the next cut and the jacks refastened, so that to cut a place 9 ft. wide three cuts are necessary, and the total time occupied is about 1 hour, made up as follows:—"The machine lay 8 ft. from the face, and the men spent 8½ minutes in placing it in position, 5 minutes were taken to prick the roof for the back jack, 2 minutes to fix the machine and run the motor light, 7 minutes to make the undercut and withdraw the chain, 6¼ minutes to move over and fix the machine for the second cut, 8¼ minutes to make the second cut, 5½ minutes to move over and fix the machine for the third cut, 7 minutes to make the third cut, 6 minutes to remove the machine from the face, the total time being 55½ minutes"; from which it is seen that more than half the time is occupied in moving the machine. There is thus ample room for the inventor.

The machine saved the sum of 4s. 9d. per yard on the prices demanded by the men, or 3s. 1d. on the price list towards power, interest on capital, depreciation and repairs, but the author was unable to ascertain the cost of power, and the machine had not been running long enough to determine the interest and depreciation. The total repairs for a period of nine months amounted to £9 13s. 9d., but this amount does not include the wages of the colliery mechanic employed in replacing broken wheels or sharpening the cutter teeth. An interesting discussion followed.

**Telegraphic Communication with St. Petersburg.**—The *Times* Paris correspondent says that new telegraphic apparatus permitting direct communication between the Russian capital and both Paris and London is to be tested this week. Hitherto St. Petersburg telegrams for Paris had gone by way of Berlin or by cable *via* Libau, Bornholm and Calais. The new transmitters are of Danish make.

## STREET LIGHTING BY NERNST LAMPS.

By HENRY JOSEPH.

Since the Nernst lamp has become a commercial article, many central station engineers have adopted it for public lighting, but there are still a large number who, frightened by the bogey of frequent renewals, still adhere to the incandescent carbon filament for the lighting of streets, which are not of sufficient importance to warrant the expense of arc lamps; and a still larger number of engineers have, so far, apparently been unable to compete with gas.

No one can deny that the supersession of gas lamps is a field in which there are very large possibilities, and that, if it be possible to compete with gas both in candle-power and yearly cost, a long-hour load bearing a considerable proportion to the normal load of the station is within grasp. It is the object of this article to show that, under favourable conditions, with the use of Nernst lamps, it is possible to produce a better light than that given by incandescent mantles at a smaller annual cost per lamp than is charged in most towns for gas lighting, and still show a small net profit, which, together with the improved load factor, will show a marked increase in the profits of the undertaking.

First, to slay the "frequent renewals" bogey.

There is no doubt that where the voltage varies over a wide range from light to heavy loads, or where the lamps are liable to frequent and considerable changes of pressure, their average life will hardly run into three figures. The same is true for lamps, the standard voltage of which does not exceed the maximum to which they are likely to be subjected, or where sufficient care is not taken to ensure correct polarity.

But our experience is that given a continuous-current supply which does not vary beyond the limits of, say, 210 and 220 volts on any part of the network, and Nernst lamps with 200-volt filaments, and 20-volt resistances, the average life of the burners is almost as long as that of carbon filament lamps, and the yearly cost of renewals is so low that the saving in current leaves no doubt as to which type ought to be adopted.

At Hythe we use ½-ampere and ¼-ampere lamps at the above voltage for public lighting, and the behaviour of the burners has proved entirely satisfactory.

The average of the first 86 ¼-ampere burners was 493 hours. Of these 21 failed to reach three figures.

| | | | | | | |
|---|---|---|---|---|---|---|
| 5 | lived | between | ... | ... | 100 and | 200 hours. |
| 3 | " | ... | ... | 200 | " | 300 " |
| 9 | " | ... | ... | 300 | " | 400 " |
| 11 | " | ... | ... | 400 | " | 500 " |
| 11 | " | ... | ... | 500 | " | 600 " |
| 3 | " | ... | ... | 600 | " | 700 " |
| 2 | " | ... | ... | 700 | " | 800 " |
| 3 | " | ... | ... | 800 | " | 900 " |
| 3 | " | ... | ... | 900 | " | 1,000 " |
| 9 | " | ... | ... | 1,000 | " | 1,100 " |
| 2 | " | ... | ... | 1,100 | " | 1,200 " |
| 4 | " | ... | ... | 1,300 | " | 1,400 " |

Several of the early burners were found to have been put to work with wrong polarity, with consequent speedy destruction, and in one or two cases the filaments or heating coils of the same lamp repeatedly failed. This was traced to faulty action of the automatic cut-out, the heating coil remaining in action after the filament had lit up, thus causing the filament and heating coil to overheat one another until one or other failed. This is easily detected by abnormal brightness, and failure from this cause is now prevented.

That the lives were greatly shortened by these initial mistakes is proved by the fact that the next 30 ¼-ampere filaments to be brought in showed an average life of no less than 1,345 hours.

Of these only one failed to reach three figures.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | lived | between | ... | ... | 300 and | 400 hours. |
| 1 | " | ... | ... | 400 | " | 500 " |
| 2 | " | ... | ... | 700 | " | 800 " |
| 1 | " | ... | ... | 800 | " | 900 " |
| 1 | " | ... | ... | 1,000 | " | 1,100 " |
| 2 | " | ... | ... | 1,100 | " | 1,200 " |
| 3 | " | ... | ... | 1,200 | " | 1,300 " |
| 1 | " | ... | ... | 1,300 | " | 1,400 " |
| 6 | " | ... | ... | 1,500 | " | 1,600 " |
| 3 | " | ... | ... | 1,600 | " | 1,700 " |
| 4 | " | ... | ... | 1,700 | " | 1,800 " |
| 4 | " | ... | ... | 1,800 | " | 1,900 " |

Several burners which are still in use have been lit over 2,000 hours.

The records of the ½-ampere burners were thought at first to have been spoilt by a number of high voltage ones being issued in error, but it was found by comparing the average of these mixed burners with that of the correctly rated ones that this error, although considerably reducing the candle-power, did not increase the average life, but apparently rather tended to decrease it.

The first 14 "mixed" burners gave an average life of 721 hours, while the next 11 200-volt burners showed an average of 780 hours.

Of these 25 ½-ampere burners, one failed to reach 100 hours.

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | lived between | ... | ... | 200 and | 300 | hours. |
| 2 | " | ... | ... | 300 " | 400 | " |
| 4 | " | ... | ... | 500 " | 600 | " |
| 3 | " | ... | ... | 600 " | 700 | " |
| 4 | " | ... | ... | 700 " | 800 | " |
| 2 | " | ... | ... | 900 " | 1,000 | " |
| 1 | " | ... | ... | 1,100 " | 1,200 | " |
| 1 | " | ... | ... | 1,200 " | 1,300 | " |
| 1 | " | ... | ... | 1,300 " | 1,400 | " |
| 1 | " | ... | ... | 1,400 " | 1,500 | " |
| 2 | " | ... | ... | 1,500 " | 1,600 | " |

The ¼-ampere lamps were used to replace ordinary batswing burners, and the ½-ampere the incandescent mantles.

The larger size gives an excellent light, and is unquestionably superior to the usual size of incandescent mantle, which, when new, is about 60 C.P. in most towns.

It falls off in brilliancy as it gets older, just as the incandescent mantle does, but its average is certainly higher.

The difference between the ¼-ampere lamp and the batswing burner, although very marked at first, is not much to boast about during the latter part of its life—that is, after the first 150 to 200 hours. In fact, I should not recommend the ¼ ampere lamp from experience for street lighting.

There is no doubt that if you wish to impress your town councillors with the desirability of adopting electric illumination for their streets, you must show them a *better* as well as a *cheaper* light than they have had before.

We have not up to the present used the newer Luna Nernst lamp for public lighting, but have had a few of these under observation for some time; they appear to have as long a life as the older pattern, and the ½-ampere size with its 115-C.P., or thereabouts, quite puts the ordinary incandescent mantle in the shade.

As regards globes, we tried a number of different kinds before we decided which to use, and finally adopted the "Prism" globe, which appears to diffuse the light the best, and give the effect of intense local brilliancy as well. In the case of the ¼-ampere lamps, we find it necessary to use the small inner globe as well, as with only the large one the heat is dissipated so fast, that many of the lamps fail to light up at all.

Another important point is the question of the best height for the light above the pavement. With lamps 55 to 70 yards apart, we find this to be about 10 ft. for the ¼-ampere, and 14 ft. for the ½-ampere lamps.

These points ought to be carefully considered in purchasing brackets to fit on existing gas standards.

We now come to the important question of costs. For the purposes of investigation, let us assume that the whole of the public lighting of a district has been taken over by the electric supply company, who contract to alter existing gas lamps to electric, connect up and supply current to the same, switch them on and off, and carry out all necessary repairs, &c., including one coat of paint to columns and brackets each year, for a fixed annual sum per lamp; the lamps being lit half an hour after sunset, and extinguished half an hour before sunrise, say, an average of 4,000 hours per annum. [This should be about 3,905 hours, but 4,000 appears to be the number estimated in many towns for all night lighting, and I have adopted it for this reason as a basis of calculation.]

We will now consider two cases that may arise.

CASE I.—The electric supply company are commencing operations, and propose to convert all the gas lamps into ½-ampere Luna Nernst, and to lay mains in all the roads and streets which are provided with public lamps, which mains will be used principally for a private supply on the three-wire system; three-cores being used for the outers and neutral, and a fourth of smaller section for supplying a certain number of public lamps through a switch off one of the outers. As it will usually be impracticable to switch on all the lamps from the station, owing to the large fourth core which this would entail, it is assumed that a number of automatic switches are provided, each controlling about 20 lamps, these switches being actuated by making the fourth core alive at the station.

It may be stated at once that this was not done at Hythe, as part of the mains had already been laid with three-core cable before the public lighting was decided upon, and, consequently, the fourth core on the newer part of the network is made alive at street corners through the switches on the lamp brackets, and it is necessary for a man to walk between 3 and 4 miles to switch on the lamps, which are fed off about 12 miles of mains.

At Sandgate, the adjacent district, the lamps are switched on by means of automatic switches actuated from two of the cores of a telephone cable.

Several methods of switching direct from the station will readily suggest themselves, and for the sake of completeness, the following one is described. (See fig. 1.)

The switch-core S is made alive off the positive at the station, and a high-resistance solenoid in the automatic

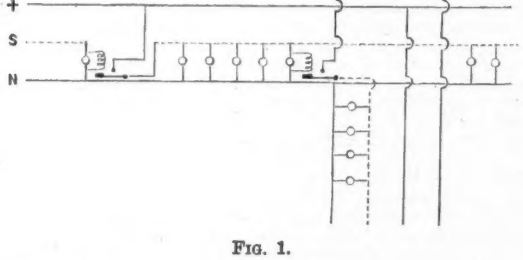


FIG. 1.

switch, which in the diagram is shown as an ordinary relay, is shunted across the first lamp, which is connected between S and neutral.

The switch makes S, which is open-circuited at the lamp, alive beyond this point off the positive core.

At any lamp, at a street corner or elsewhere where it is desired to take off another circuit, another automatic switch is similarly inserted, so as to make the lamp core of the branch cable alive off the negative.

This process can be continued indefinitely, each circuit switching on the one next to it.

We will now proceed with the details of the cost.

This is made up of the following items:—

*Capital Charges.*—Lamp brackets, reflectors, and globes; Nernst lamps; lamp service cable; joint-boxes, &c.; labour for fitting, jointing, trenching, &c.; repairs to trenching; switch-gear; and a proportion on main cables.

*Revenue Charges.*—Current, renewals, repairs, maintenance, painting, &c.

*Lamp Brackets.*—Swan-neck brackets for fixing to ordinary lamp columns can be obtained for £1 15s. 6d. each complete, with prism globes and reflectors.

*Nernst Lamps.*—½-ampere Luna type, price 15s. each net.

*Lamp Service Cable.*—It is assumed that the main is laid on one side of the road only, and that it is necessary to cross for every other lamp. If the average width of the road from cable to column is 40 ft., this will mean an average of 20 ft. per lamp for crossings; and if the cable is laid about 18 in. deep, this gives with bend into base of column 2 ft., pavement to fuse-box on bracket, say, 16 ft., making a total of 38 ft., or about 13 yards. Two-core lead-covered and armoured cable single 18-wire costs £39 per 1,000 yards, or 10s. per lamp.

*Joint-box.*—One tee-box, compound, and fittings, 17s.

*Labour.*—One jointer at 8½d., and one labourer at 5½d., will do one road crossing and one other lamp in 10½ hours = 12s. 3d. per lamp.

*Repairs to Trenching.*—At 1s. per yard, say 8s. per lamp.

*Automatic Switches.*—These can be obtained in a cast-iron box, which can be fixed in the base of the column, if this is

large enough, or clamped to the post. Price £1 17s. each. Labour for fixing and connecting up, 13s. Total, £2 10s. Each would control 20 lamps, therefore cost per lamp = 2s. 6d.

*Main Cable.*—Cost of extra ·012 sq. in. core varies according to the size of the cable; the average would be about £15 per 1,000 yards of cable; assuming 15 lamps per 1,000 yds., we have cost of extra core per lamp = £1. No allowance has been made for the other three cores, as a few street lamps would not affect the size of cable installed.

*Current.*—The cost of current is taken to be the cost of generating extra units during the time that the plant is running.

There should be no charge for labour, &c.; in fact, the only items would be coal, water, oil, and waste. We may safely put this down at ·75d. per unit output as an average figure. Assuming 4,000 hours per annum with ½-ampere lamps, we have 420 units at ·75d. = £1 6s. 3d.

*Renewals.*—Average life, say, 700 hours, or six renewals per lamp per year. Price of burners, 1s. 10d. net.; labour, 6d.; total, 2s. 4d. × 6 = 14s.

*Repairs and Maintenance.*—This item, after allowing for renewals, is practically negligible; suppose we say 1s. per annum.

*Painting.*—One coat per lamp, 1s. 3d.

SUMMARY.

| | | | |
|---|---|---|---|
| *Capital Charges*— | | | |
| Lamp bracket, &c. ... ... ... | £1 | 15 | 6 |
| Nernst lamp ... ... ... ... | 0 | 15 | 0 |
| Service cable ... ... ... ... | 0 | 10 | 0 |
| Tee-box ... ... ... ... ... | 0 | 17 | 0 |
| Labour ... ... ... ... ... | 0 | 12 | 3 |
| Repairs to trenching ... ... ... | 0 | 8 | 0 |
| Switchgear ... ... ... ... ... | 0 | 2 | 6 |
| Main cable ... ... ... ... ... | 1 | 0 | 0 |
| Total ... ... ... | £6 | 0 | 3 |
| Interest on £6 0s. 3d. at 5 per cent. = 6s. | | | |
| *Revenue Charges*— | | | |
| Interest on capital... ... ... ... | £0 | 6 | 0 |
| Current ... ... ... ... ... | 1 | 6 | 3 |
| Renewals ... ... ... ... ... | 0 | 14 | 0 |
| Repairs, maintenance, &c. ... ... | 0 | 2 | 3 |
| Total yearly cost ... ... ... | £2 | 8 | 6 |

CASE II.—The supply company have laid three-core mains in practically all the streets where a supply is required for public lighting.

In this case the items under "Capital" for switchgear and main cables are eliminated, and their place taken in the revenue charges by cost of lamplighter's wages.

A man will light on an average about 80 lamps in 1½ hours, or 3 hours per day. To this add a quarter of an hour's walk to the nearest lamp (he would probably live in the neighbourhood of the lamps he had to light) giving a total of 4 hours per day, or 1,460 hours per year, which at 6d. per hour = £36 10s. for 80 lamps, or 9s. 1½d. per lamp.

Deducting interest at 5 per cent. on £1 2s. 6d. (switchgear and extra core in main cables), *i.e.*, about 1s. 1½d., we have to add 8s. to the figure arrived at in Case I., viz., £2 8s. 6d., giving a total in this case of £2 16s. 6d.

In many towns, as at Hythe, a combination of these two cases may be possible, when by means of 4-core cable in side streets the item for lamplighters' wages may be considerably reduced.

It will doubtless be admitted that in arriving at these figures all costs have been liberally allowed for, in fact, they have all been taken from actual experience, and the following will show that in many districts these costs will allow for an inclusive annual price being charged, which, while leaving a small margin for profit, is considerably lower than the price at present paid for gas lighting.

An average has been taken of the cost in 71 towns in England of gas, lighting and extinguishing, repairs, maintenance, &c., which costs do not include any capital charges such as lanterns, or service connections, &c. They refer to what are termed "ordinary" batswing burners using on an average about 4 cb. ft. of gas per hour, and incandescents varying from 60 to 30 C.P.

The lighting hours, of course, vary, and, in adjusting the cost per lamp for each town, to the equivalent of 4,000 hours' burning per year, I have considered that a certain percentage increase in the number of hours per year would only mean half this percentage increase in cost.

On this basis the average works out at £3 12s. 6d. per lamp per annum, which is so far in excess of the figures given for electric lighting, that it certainly seems to bear out the contention that in many cases there should be no great difficulty in obtaining a contract for public lighting by electricity, especially in towns where a new scheme is being carried out. In many towns, the cost for lighting by gas up to 11.30 or midnight only is over £2 15s., while the highest figure for about 4,000 (actual) hours is £7 19s., and the lowest £2 5s., there being only seven towns out of the total of 71 with costs anything like as low as this.

This is clearly a question of "dumping," and the central station engineer has to ask himself the question, "Can I dump current at ¾d. a unit?" If so, and the inclusive cost of gas lighting in his district is not exceptionally low, and the Town Councillors are not all shareholders in the gas company, he ought to be able to fix up a contract for public lighting by Nernst lamps which will not only show a profit, but also help him to materially reduce his costs per unit generated.

## THE CONDUCTOMETER.

BY ROLLO APPLEYARD.

AN article by Mr. John Rymer-Jones, beginning in the ELECTRICAL REVIEW of April 29th, and ending in the issue of May 6th, deals with the relative merits of my conductometer, and those of "a simple 'metre bridge' . . . . without any alterations or additions." It must be by some mischance that he ignores the cardinal fact that the conductometer lends itself with complete facility to measurements of percentage conductivity by the *mass* method; and it must be by inadvertence that, for the purposes of the article, he annexes the scale of my conductometer, inserting it in his Diagram 2, p. 727, as his Scale B, and that he discourses about the combination as "a simple 'metre bridge' . . . . without any alterations or additions." In defence of my instrument, I am, therefore, obliged to state that the particular graduation of that Scale B is described for the first time in my Patent No. 28,943 of December 31st, 1902, and that it is an essential and characteristic feature of the invention. Again, in describing the supposed limitations of my instrument, the article erroneously suggests that "the conductometer requires the diameter to be measured *before* testing, and if done only *immediately* prior to balancing, as is said to be the practice, gauging delays the process of testing." The truth is, that the conductometer puts no restriction whatever upon the operator as to the particular stage of the testing at which the wires are to be either weighed or gauged; it is simply a mechanical device provided with scales, whereby the corrections to the ordinary slide-bridge are applied by easy manipulation. The operator may use this mechanical device at any time he pleases, either before or after the electrical balancing. In view, however, of the labour involved in repeatedly turning over and handling several tons of copper wire, it is often convenient, and always economical, to complete the gauging and the electrical balancing at a single handling. With the conductometer, the whole operation of gauging, electrical balancing, and labelling a hank with its mean diameter, and with its measured percentage conductivity, takes on the average *less than half a minute.* How, then, in any part of the process, can there be said to be "delay"? We are further reminded (p. 727) that with some other methods "the correction for any difference per cent. in weight may be allowed for at leisure." So it may, if desired, with the conductometer. But when stranders are calling out for wire, there is little leisure; and, moreover, any such postponement of the report from the testing-bench retards the flow of work through the shop, and fills up the floor space with unpassed stacks of wire. In a word, electrical balancing and either gauging or weighing are essential to all conductivity tests; extensive arithmetic is not. Consequently, if time and trouble, and the chances of arithmetical

error are to be reduced, we must seek to perform the arithmetic automatically. We must evaluate the greatest error that can be allowed in the final result, and we must design the mechanical arithmetic-device accordingly.

There is another point upon which it would be interesting to have further information. In describing a method which he says has been in use "for many years," Mr. John Rymer-Jones informs us that "the standard is given a resistance equivalent to a wire of 100 per cent. purity, and of the *exact specified weight*, by adjusting its length to something more or less than 30 ft., as required." I should be glad to know how many years this method of adjustment of the standard to 100 per cent. has been in use, the plan adopted for measuring the revised length of wire, the time taken to complete a test by that system, and the degree of precision attained. In my paper on the conductometer (*Proc. Inst. C.E.*, Vol. cliv., Session 1902-3, Part IV.) it is mentioned that, "from the known length and diameter of the standard wire the resistance corresponding to 100 per cent. conductivity may be calculated for wire of the gauge under test, and this resistance may then be inserted in the bridge-arm instead of a standard wire. Or, using a preliminary test wire of known conductivity, setting the slider to the position on the bridge which would give balance if the standard were 100 per cent., and keeping the slider in this position, the length of the standard wire may be adjusted until balance is obtained." But I also show that, with the conductometer, all this careful work can be avoided by a simple setting of the "conductivity scale"—an operation which is performed in about one second of time. The conductometer is put forward, not as an instrument for the extreme refinements of laboratories, but as a commercial instrument adequately fulfilling all the requirements of practical routine work. It can be used by an intelligent factory-hand with the ease and certainty of a slide-rule—which, in effect, it is. As the article by Mr. Rymer-Jones is calculated to be detrimental to the reception of the instrument, I will endeavour to give a sufficiently detailed account of it to enable an impartial mind to form its own opinion.

The problem to be solved was:—(1) To find an expression for the successive positions of balance corresponding to successive unit increments of percentage conductivity of a test wire when balanced on a slide-bridge against a standard wire; (2) To find how to compensate the scale readings if the standard wire happens to represent other than 100 per cent. conductivity; (3) To find how to compensate for small differences of *diameter* between successive wires and the standard wire; (4) To find how to compensate for small differences of *mass* between successive wires and the standard wire; (5) To design a direct-reading instrument to enable the corrections to be applied with the greatest possible simplicity; (6) To determine the limits of accuracy, and the safe range of measurement with such an instrument. I arrived at the graduations as follows:—

Let there be two wires, of equal length and of equal diameter, balanced upon a slide-bridge. Let their percentage conductivities be $(100 + w)$ and $(100 + x)$ respectively, and their resistances $R_2$, $R_1$, respectively. Then

$$(100 + w)\,R_1 = (100 + x)\,R_2. \qquad (1)$$

If the bridge-wire is divided into 100 equal parts, and if balance is at L, such parts

$$(100 - L)\,R_1 = L\,R_2. \qquad (2)$$

From (1) and (2)

$$L = \frac{100\,(100 + x)}{200 + x + w}, \qquad (3)$$

or, if $w = o$,

$$L = \frac{100\,(100 + x)}{200 + x}. \qquad (3a)$$

If now, in (3) $w$ be supposed constant,

$$\frac{\delta L}{\delta x} = \frac{100\,(100 + w)}{(200 + x + w)^2}.$$

Let $\delta x = 1$, corresponding to 1 per cent. change of conductivity, then

$$\delta L = \frac{100\,(100 + w)}{(200 + x + w)^2}.$$

The limiting case is when $x = w = o$, giving

$$\delta L = \frac{10{,}000}{40{,}000} = 0{\cdot}25 \text{ scale division.}$$

As each division is $\frac{1}{100}$th of the length of the bridge-wire, this means that, for positions near the middle of the bridge-wire, 1 per cent. change of conductivity of the test wire will correspond to a movement of the slider through approximately $\frac{1}{400}$th of the length of the bridge-wire. The next step was to imagine a bridge-wire graduated into $\frac{1}{400}$ths, and to calculate the small errors due to this uniformly divided scale. These small errors will be found evaluated in my paper (*Proc. C.E.*) l.c. The patent describes the conductometer as an instrument "of the wire-bridge type," which may be graduated in equal divisions on the conductivity scale. And it states that "a difference of 1 per cent. in the conductivity above or below 100 Matthiessen means a displacement of the balancing point by an amount practically equal to $\frac{1}{400}$th of the total length of the bridge wire, and that if this unit of length be adopted for the graduation of the conductivity scale, "an accuracy of 0·1 per cent. is attained within the limits of 95 per cent. to 105 per cent. conductivity of the standard, a range which is quite sufficient for the usual routine tests for high conductivity copper." We are, therefore, able to judge as to how far diagrams 1 and 2, p. 727, represent "a simple slide bridge . . . . without any alterations or additions," and as to how far the conductometer scale has been there appropriated for critical comparison with itself.

*(To be continued.)*

## AUTOMATIC OVERLOAD AND REVERSE CURRENT CUT-OUTS.

On Thursday and Friday last week, those who were so well advised as to avail themselves of the opportunity were treated to a masterly exposition of the principles involved in the construction of reverse current and other circuit-breakers, with practical demonstrations, by Mr. Leonard Andrews, who has made this subject peculiarly his own. The demonstration took place at the showrooms of Messrs. Cowans, Ltd., 82, Victoria Street, S.W., where a variety of circuit-breakers had been specially fitted up for the purpose.

Mr. Andrews first explained how the early differential type of reverse current cut-out fails, due to a heavy reverse current swamping the effect of the shunt winding, just as the N-pole of a powerful bar magnet will attract the N-pole of a weak one, when the latter is near enough to the former to be oppositely magnetised by induction. Next, the motor type, which Mr. Andrews described before the I.E.E. six years ago, was shown to fail for the same reason, owing to the necessity of giving the H-armature a slight backward set to ensure its not acting with a forward overload. In this connection, it appears to us that the failure was simply due to the use of an H-armature, and the consequent variation of magnetic reluctance according to its angular position. If a uniformly slotted or smooth-core cylindrical armature were employed, the iron core would have no tendency to rotate, no matter how great the forward or reverse current, and the rotation of the armature would depend solely upon the relative directions of the shunt and series currents.

However, the difficulty has been entirely overcome in a most ingenious manner, by adopting a closed magnetic circuit upon which the forward series and shunt ampere-turns act in conjunction, with a magnetic shunt between them consisting of a movable plunger. The latter is unaffected so long as the series current is in the forward sense, regardless of its magnitude; but upon the reversal of the series current the core is magnetised and attracted, even if a very heavy reverse current is flowing. Moreover, the device will operate even when the bus-bar voltage falls to a very low value.

A pendulum polarised relay suitable for both direct and alternating current was shown in electrical connection with a circuit-breaker, after which the alternating current direction indicator devised by Mr. Andrews was explained. By combining with this a non-polarised relay, an alternating current reverse current cut-out is obtained, which was shown to

operate satisfactorily, even when the bus-bar voltage was only 25 per cent. of the normal. The principle of the current direction indicator is extremely ingenious; we hope shortly to give a detailed description of this and of the other apparatus exhibited, which included Mr. Andrews' perfected system of protecting duplicate feeders; a new time-element cut-out, having a time lag inversely proportional to the magnitude of the load; and a scientifically arranged system of extra high pressure switchgear. Mr. Andrews and Messrs. Cowan are to be congratulated both on the manner of the demonstration, and on the exceedingly interesting matters with which it dealt.

## UNDERGROUND ELECTRICAL SUB-STATIONS.

In a memorandum recently issued by the Board of Trade, under the Factory and Workshop Act, 1901, certain recommendations are embodied in regard to underground electrical sub-stations. The memorandum deals with dimensions, construction, ventilation, manhole covers, and stairways, and the arrangement and protection of the apparatus.

It is remarked that many sub-stations have been constructed and fitted up in a manner dangerous to people having to enter them, and that this largely arises from their insufficient size or through faulty design of the chambers, matters which cannot be remedied without practically reconstructing them. It is recommended that a tall man should be able to stand upright on the working floor without touching the roof or any cables, and for this a height of 7 ft. will suffice.

The area should be such that ample space is allowed to walk past transformers and to work the switches, also if the chamber is narrow it should be long enough to allow of the L.P. board not being immediately opposite the H.P. board.

The switchboard should not be fixed on the wall above transformers, so that the operator is often in contact with the transformer cases or stands on them. Transformers made by different firms vary considerably in dimensions, but in general a minimum area of 4 ft. square would be sufficient for single transformer chambers, and would allow of a satisfactory arrangement of switchboards. When out-puts larger than 30 KW. are required, the chambers should be large enough to accommodate an out-put of 75 KW., and for such stations it is proposed that there shall be a minimum width of 5 ft. and a minimum area of 50 sq. ft., the actual shape of the station depending on local circumstances within these limits. If the plan of the chamber is a square, the minimum inside dimensions for 75 KW. will therefore be practically 7 ft. cube, which is in accordance with recent practice.

No part of the above area should be utilised as an entrance to the chamber. An additional space in the case of the single transformer (30 KW.) chamber not less than 2 ft. by 2 ft., and in the case of a 75 KW. (or more) chamber not less than 3 ft. by 3 ft. should be provided for the purpose of entry. Entrance through the roof of the chamber proper is objectionable, because (*a*) if any water enters, it falls on that part of the floor which it is important to keep dry, (*b*) the necessary ladder obstructs the working space, and (*c*) a person going down the ladder frequently has to descend very close to live conductors. Entrance should, therefore, always be at the end or side of the chamber proper.

For every 10 KW. additional above 75 KW. capacity, not less than 5 sq. ft. should be added to the floor area.

In the case of double-floor stations, chambers may be used for double the output of single-floor chambers of the same area, provided that the height from the working platform to the roof is not less than 7 ft., and the height below the working platform and the floor not less than 6 ft. It is obviously essential that the chambers should be watertight. Glass pavement lights are not recommended, as they are generally found to give trouble by leakage and condensation of water on the under side.

It is desirable that the floor be laid on an incline of not less than 1 in 100 towards a sump situate in the entrance annexe, immediately below the manhole. The sump should not be connected with the town drainage system, to avoid flooding of the chambers by water "backing up" the drain during thunderstorms or heavy rains; also in the event of the trap being allowed to become dry, to prevent the chamber becoming filled with sewer gas.

For ventilation purposes it is necessary to provide an inlet duct at one end of the chamber, and an outlet duct at the other. It is preferable that the inlet be near the floor of the chamber, and the outlet near the roof. To maintain a sufficient current of air an electric fan at the mouth of the outlet duct is recommended. The sectional area of each duct should be not less than 1 sq. in. for every 10 cb. ft. capacity of the chamber. This rule, which is in accordance with modern practice, will give for a 30-KW. chamber an area about equal to that of a pipe of 4 in. diameter; and, for a 75-KW. chamber, 7 in. diameter. Where possible the ducts should be led above the ground level into special ventilating posts or up the wall of adjacent houses. In any case it is advisable that the mouth of the outlet duct be not immediately over the switchboards or transformers.

Except in very large chambers, one entrance serves for the access of workmen and also for the introduction of transformers and apparatus. For the latter purpose the opening must, in general, be not less than 2 ft. square, but is often considerably larger. A cover opening to the full size of the manhole is to be preferred. A cover which appears to meet the requirements, is provided with a trough round the inside of the frame to catch any water, the trough being drained by a pipe leading to the street gutter. A cover frequently used provides for the lid being locked back when open; a grating, which can be readily opened from the inside, covers the opening when the lid is open. An iron ladder at an angle to the wall, with flat treads, is preferable to a vertical ladder or iron bars built into the brickwork.

It is recommended that a door and a stairway should be provided for sub-stations which have to be frequently visited, and for all sub-stations of over 300 KW. capacity.

*Arrangement and Protection of Apparatus.*—A clear passage not less than 3 ft. wide should be provided in front of the apparatus which has to be handled. All high-pressure apparatus or cables should be distinguished by means of red paint or otherwise, and should be kept, as far as possible, in a distinct portion of the station. High-pressure and low-pressure switchboards should be kept apart, and all high-pressure apparatus and cables should be protected so that accidental contact with the same is impossible.

The metallic portion, other than the conductors of every transformer, must be efficiently connected with earth, in accordance with the Board of Trade regulations, and other metal work not in connection with the circuits should, where practicable, be connected to earth. Wherever nuts are used on electrical apparatus, it is recommended that they be secured by lock-nuts.

Switchboards with cable connections at the back, should have a clear space at the back of the boards not less than 3 ft. wide. The chamber will, therefore, have to be larger accordingly for this class of switchboard, unless it is arranged that all pressure can be entirely cut off from the sub-station when examination or work at the back of the boards is undertaken. It is recommended that a telephone communicating with the generating station be provided in every sub-station. No conductors or live metal should be within reach of a person on the entrance ladder. Fuses used in the low pressure, as well as the high pressure, circuits, should be of the switch-fuse or other type in which the fuse can be replaced when necessary without the handling of live metal. It is recommended that insulating platforms or india-rubber mats be in any case provided. The latter, however, must be kept dry.

When any cleaning, necessitating the shutting off of the supply, has to be undertaken, precautions should be taken to ascertain definitely that the supply has been cut off, not only from the high pressure feeding main generally in use, but also from any duplicate or inter-connecting feeder. It is important that the arrangement of switchgear, cables, &c., be carried out on a systemmatic and orderly plan.

## STEAM TURBINE ECONOMY.

Writing in the *Electrical World and Engineer*, Mr. Mattice refers to the question of the vacuum necessary for the turbine, and he controverts the popular opinion that the turbine is more in need of vacuum than the reciprocating engine while, at the same time, he admits that it gains more as the degree of vacuum increases. In fact, there is on this point a distinct appearance of having his cake and eating it simultaneously, which is an impossible thing, as we were taught in the nursery. He claims that all engineers are daily appreciating the value of vacuum, which is true in a limited degree. Since steam engine practice has been so largely controlled by the exigencies of electrical work, the tendency has been to neglect condensing. Chief engineers too frequently have looked complacently on vacuum gauges reading 16 in. and 20 in. where the condenser outflow has not been above 100° F. This is, of course, an altogether inexcusable thing, indicative of air leakages rather than inefficient condensation, and it is high time that engineers should begin to appreciate high vacua. At the same time, the last fraction may be attained at a cost in temperature that is hardly worth while incurring, and the utmost care must be taken that a good vacuum is really the product of temperature and air tightness, and not produced by excessive air-pump work. Mr. Mattice thinks it is easier to obtain a good vacuum with the turbine than with ordinary engines, because there is less leakage at glands. As regards the power required to drive an air pump, Mr. Mattice quotes a case of a turbine of 2,120 B.H.P. with a vacuum of 27·89 in. on a barometer of 29·18. The power to drive the air pump was 14·4 I.H.P., or less than 0·7 of 1 per cent. of the main power.

Assuming that all this power was consumed in raising the vacuum from 27 in. to 28 in., and that the air-pump engine used 25 lbs. of steam per H.P.-hour, this would show 360 lbs. of steam per hour for 1 in. extra vacuum. Yet tests show that an increase of 1 in. of vacuum showed 0·68 lb. reduction of steam consumption per KW.-hour at 1,250 KW., the rated power of the turbine; this represents 850 lbs. per hour of steam saved by 1 in. of vacuum, costing 360 lbs. of steam to obtain, on the above liberal assumption. The saving is 490 lbs., or fully 2 per cent. of the total steam consumption of the turbine, which is worth saving. Actually the saving is greater than this, because the whole of the vacuum only demands the power debited to the last inch.

The gain from superheat, says Mr. Mattice, is too well known to require argument. Really, one would think that this was so; but, if Mr. Mattice would come over to this country, he would find that engineers in but few cases understood superheat thoroughly, and rarely appreciated it at its true value. American engineers are looking into the question of superheat in a way that points to their securing a sound knowledge of it. The makeshift way in which the subject is treated in this country offers but a poor prospect of success. It has been pointed out that super-

heaters are looked on too much as cheap accessories of a boiler, whereas, properly speaking, the boiler should be a well-made accessory to a superheater. We heard recently of some tests made upon a superheating plant in which the experimenters had not even gone to the trouble of putting reliable steam gauges before and after the superheater, so as to find the drop of pressure in the small pipes. This drop of pressure is sometimes from 15 lbs. to 25 lbs. and to secure good effects it ought not to be more than 2 lbs. or 3 lbs. Yet superheaters are put in by dozens, which produce wire-drawing of 12 lbs. to 20 lbs., and engineers don't even know it.

## OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Nemo" writes:—"1. Is it legal for a local authority to lease a provisional order to a company?

"2. If so, should the local authority insert a clause in the agreement or lease, giving them the right to cancel the same at their option at the end of certain definite periods, say, 7, 14 and 21 years.

"3. Are there any other clauses of a legal or technical nature which it would be usual or advisable to insert in the agreement to safeguard the interests of the local authority?

"4. Does the Board of Trade issue a model agreement for such a transaction? If not, where could one be seen so that some idea could be formed of what is usual?"

*** With regard to the first question put by "Nemo," the answer appears to be furnished by the Electric Lighting Act, 1882, of which Sec. 11 provides that:—"Any local authority who have obtained a licence, order, or special Act for the supply of electricity, may contract with any company or person for the execution and maintenance of any works needed for the purposes of such supply, or for the supply of electricity within any area mentioned in such licence, order or special Act, or in any part of such area; but no local authority, company, or person shall by any contract or assignment, transfer to any other company or person, or divest themselves of any legal powers given to them, or any legal liabilities imposed on them by this Act, or by any licence or special Act, without the consent of the Board of Trade."

It would seem from this section that if the Board of Trade consent, an agreement for a lease may be entered into.

With regard to queries 2, 3 and 4, the form of lease must depend upon the peculiar circumstances of each case. "Nemo" might apply to the Board of Trade for a form of lease. It is not known, however, that such forms have been drawn up.

## NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

9,397. "Improvements in and relating to 'clusters' for incandescent electric lamps." J. H. Dale. April 25th.

9,427. "An automatic electro-magnetic sanding-gear for use on electric railways and tramways operated instantaneously with the electric emergency brake from the controller handle." C. W. Crosbie and A. Ward. April 25th.

9,442. "Improvements in relation to resonators for use with currents of high frequency wireless telegraphy and other like purposes." C. A. Wright. April 25th.

9,443. "Improvements in relation to vacuum electrodes for the production of X-rays with currents of high frequency.' C. A. Wright. April 25th.

9,253. "Improvements in electric shoes." J. W. Gibbs. April 25th. (Date applied for under Patents Act, 1901, July 16th, 1903, being date of application in United States.) (Complete.)

9,468. "Improvements in or relating to a method of and apparatus for heating he charge of electric furnaces." A. Neuburger. April 25th. (Complete.)

9,517. "Improvements in insulators." A. Richardson, J. Heap, H. Heap, J. Bailey, T. Brierley, and R. Billington. April 26th.

9,518. "Improvements in hangers or ears for overhead trolley wires." A. Richardson, J. Heap, H. Heap, J. Bailey, T. Brierley, and R. Billington. April 26th.

9,523. "Improvements in battery cells." W. O. Duntley. April 26th. (Complete.)

9,527. "High frequency effluve respiration for inhalation of electronized air, gas, or vapours." H. A. Kent. April 26th.

9,530. "Improvements in the electrical ignition used in connection with internal combustion motors and the like." C. Ridley and J. Ridley. April 26th.

9,542. "Sparking plugs for use in connection with the electric ignition systems of internal combustion engines." W. Williams. April 26th.

9,547. "Improvements in electrodes." H. C. Levis. (The General Electric Co., United States.) April 26th.

9,565. "Improvements in electric tramway or railway vehicles." J. S. Raworth. April 26th.

9,581. "Improvements in electric motors." R. McNeill. April 26th. (Complete.)

9,647. "Improvements in electro-magnetic igniters for explosion motors." P. Pichard and E. Meunier. April 27th. (Complete.)

9,649. "Improvements in connection with gas and electric light brackets and fittings for the same." A. Rudd. April 27th.

9,658. "Improvements in machines for making incandescent electric lamps. The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 27th.

9,660. "Improvements in starting devices for electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 12th.

9,669. "Improvements in electric telegraph apparatus." Siemens Bros. and Co., Ltd., G. S. Grimston, and F. Turner. April 27th.

9,688. "A sanitary rotating diaphragm for telephones." S. Churchill-Otton. April 27th. (Complete.)

9,718. "Improvements in or relating to electric lamps especially applicable to electric lamps of the character known as 'vapour arc lamps' or 'luminous vapour electric lamps.'" C. O. Bastian. April 28th.

9,744. "Improvements in water-tight covers for electric tumbler switches." The General Contracts Co., Ltd., and W. H. Flood. April 28th.

9,796. "An electrolytic resistance for electro-therapeutic use." J. G. Everett. April 29th.

9,802. "An improved electric ignition plug for internal combustion or explosion engines." A. Howson. April 29th.

9,881. "Improved means for the regulation of electric circuits for the production of constant current and or constant potential." R. W. James. (The Northern Electric Co., United States.) (Complete.) April 29th.

9,840. "Improvements in and relating to electric alarm appliances." L. Laufer. April 29th.

9,841. "Improvements in commutators for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 29th.

9,843. "Improvements in incandescent lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 29th.

9,844. "Improvements in vapour electric apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) April 29th.

9,874. "Improvements in electric switches." G. S. Dunn. (Date applied for under Patents Act, 1901, August 25th, 1903, being date of application in United States.) April 29th. (Complete.)

9,914 "Magneto electric igniting device." C. Hauptmann. April 30th. (Complete.)

9,950. "Improvements in or relating to the collector rings of alternating-current generators and motors." C. de Kando. April 30th. (Complete.)

9,959. "Improvements in electrically-driven steering gear." W. H. Harfield. April 30th.

9,964. "Electrical percussive drill." P. Centner. April 30th.

9,969. "Improvements in electrically-driven coal-whips or hoists." J. Wilhelmi. April 30th.

9,981. "Shade-carrier for electric glow-lamps and the like." K. Walther. April 30th. (Complete.)

9,984. "Improvements in or relating to electric cable conductors." W. E. Hitch. April 30th.

**High Pressure Gas Transmission.**—Readers of these columns who dare to sympathise with the gas transmission proposals lately brought forward by Mr. C. A. Smith, in the face of the scepticism usual on such occasions, may draw some comfort from the fact that just such a high pressure system is now under construction by the Laclede Gas Light Co. of St. Louis, for the purpose of more economically conveying illuminating gas over an area embracing 65 square miles. Three systems were considered:—(1) large low pressure feeder from a central holder to centre of district to be covered; (2) medium sized feeders from the main holder to an auxiliary holder in the centre of the district; (3) high pressure feeder to distributing centres and reducing valves for obtaining the service pressures. The enormous expense of construction prohibited the first two methods, and the third was adopted.

The pressures to be employed at St. Louis are approximately 5 lbs. per sq. in. on the medium pressure feeders, and from 20 to 80 lbs. per sq. in. for the high pressure suburban transmission pipes. The 5 lb. pressure limit was chosen for the medium pressure system on account of the use of cast-iron mains, but for the high pressure system iron pipes with screwed fittings will be used. With this construction any desired pressure can be carried, and the distribution radius extended to 100 miles if necessary. In the medium pressure system a blowing set, consisting of a blower direct driven by a 300-H.P. Westinghouse horizontal gas engine, is used. The engine uses ordinary illuminating gas, and is controlled by an automatic pressure governor.

This installation, according to the *Journal of Electricity, Power and Gas*, of San Francisco, is one of the first of its kind in the illuminating gas field; the system has, however, long been in use for the distribution of natural gas.

**The Permanent Expansion of Cast-Iron.**—Mr. Alex. E. Outerbridge writes to the *Journal of the Franklin Institute*, April, 1904, to draw attention to a curious property of cast-iron which he has discovered, and which has an important bearing on its use as a constructive material for buildings. It appears that the volume of cast-iron is permanently increased after it has been heated. This effect is attributed to the action of the gases occluded in the cast-iron. The action of these gases, when heated, is to create innumerable spaces or cracks in the metal, which, though not visible to the naked eye, can be plainly seen under the microscope. Cast-iron disintegrated in this way by occluded gases, when placed in water for some time, absorbs a considerable amount of the fluid, and increases in weight. The importance of understanding this property of cast-iron was shown by the observations made after the recent great fire at Baltimore. It was found that the cast-iron framework of doors, set in granite, had expanded to a considerable extent, and had not again contracted. Steel appears to be entirely free from this defect of permanent expansion, for, in every case where the "roasted" Baltimore buildings had steel framework, it remained apparently plumb and intact. Mr. Outerbridge suggests that radium might be used for detecting flaws in cast-iron and steel, and some radiographs with which his letter is illustrated show that cast-iron is distinctly more transparent than steel to the rays of radium.